MODERN PLASTICS

NOVEMBER 1959

Luxury look in PE drapes—costed to compete *p. 108*

MODERN

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PLASTICS*

NOVEMBER 1959
Volume 37 Number 3

• ENGINEERING

• TECHNICAL

• DEPARTMENTS

Coming Up . . .

December lead will deal with the Specialty Phenolics, literally precocious children of the old plastics workhorse which are doing useful work in new fields . . . Cover and a feature article will present structural reinforced plastics as used in the United States Pavilion at the Moscow Exhibition . . . Another feature will be on a new electric floor scrubber with 35 plastics parts, superbly engineered . . . Articles Nos. 15 and 16 in our series on epoxies, these concerning electronic and electrical applications, including potting and motor making . . . A complete review of the exhibition "Plastics 1959" held in Düsseldorf, Federal Republic of Germany, last month, plus coverage of the conferences there . . . An Engineering Section article will present know-how in making polyether foam . . . Plus an analysis of methods of extrusion chill-casting of polyethylene film . . . And January will be the Annual Review and Forecast issue, this year proving of tremendous progress.

Modern Plastics issued monthly by Breskin Publications Inc. at Emmett St., Bristol, Conn. Modern Plastics Encyclopedia Issue published as the second issue in September by Plastics Catalogue Corp. at Emmett St., Bristol, Conn. Second class postage paid at Bristol, Conn. Subscription rates (including Modern Plastics Encyclopedia issue), payable in U. S. currency; in United States, its possessions and Canada, 1 year $7, 2 years $12, 3 years $17; all other countries, 1 year $25, 2 years $45, 3 years $60. Single copies 75¢ each (Show issue, $1.00; Encyclopedia issue, $3.00) in the U. S., its possessions and Canada, all other countrise $2.50 (Show issue, $3.00; Encyclopedia issue $6.00).

Another new development using

B.F.Goodrich Chemical *raw materials*

Now gas comes home through pipe of Geon

The pipe in this natural gas distribution system is made of Geon rigid vinyl. Years from now it will be feeding gas to homes just as efficiently as the day after installation. This pipe stays smooth inside and out because it is not affected by the corrosive influences that affect ordinary pipe. No problems from salt water, chemicals, acid or alkaline soils, or galvanic corrosion.

Conduit or pipe made of Geon provides high tensile and impact strength. It stands up under pressure, resisting effects of fungi, bacteria, moisture, heat or cold. It makes a big hit with installation crews, since it is so light weight and so easy to install.

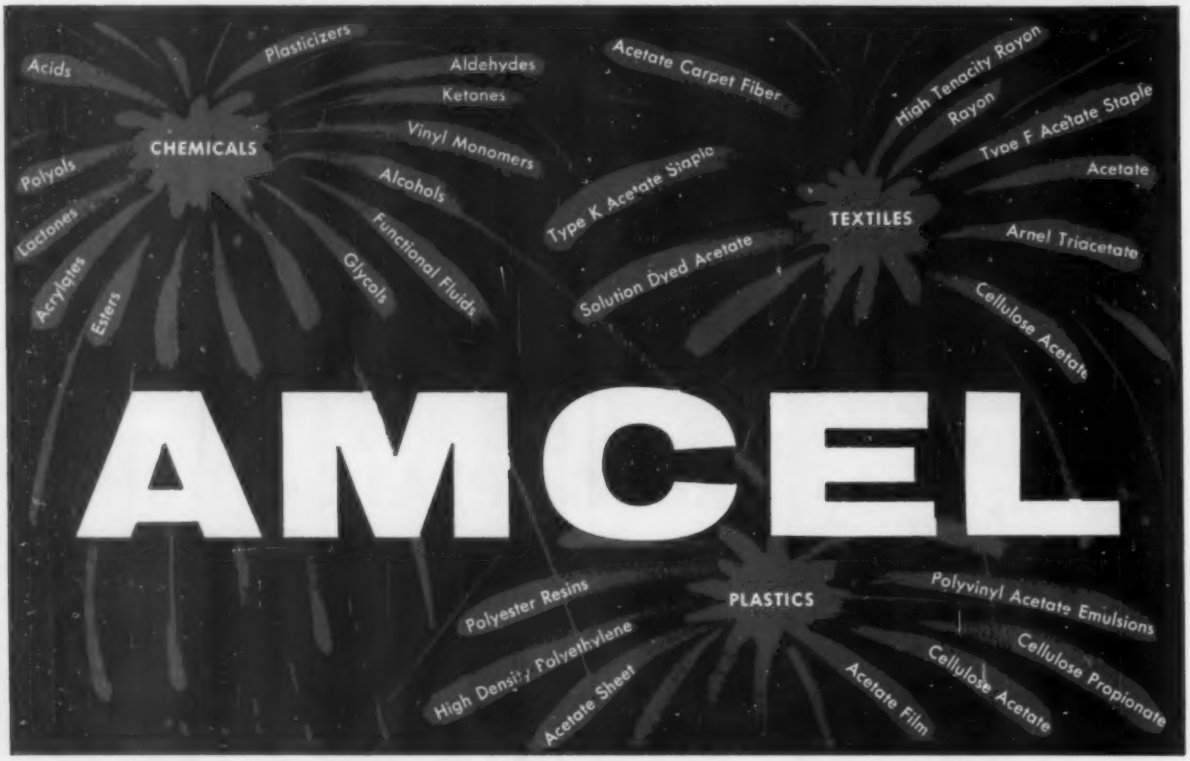
Engineers are taking advantage of the properties of versatile Geon polyvinyl material for this and many other types of applications. For information, write Dept. AF-9, B. F. Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

1¼" diameter pipe of Geon rigid vinyl is being installed by Illinois Power Company in gas lines leading to homes at Decatur, Illinois. In addition, ¾" vinyl pipe is being inserted in reamed-out 1¼" iron pipe under streets to avoid breaking the pavement to repair leaking gas lines. Kraloy Plastic Pipe Company, Los Angeles, California, makes the pipe. B.F.Goodrich Chemical Company supplies the Geon rigid vinyl.

Geon *Polyvinyl Materials*

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers



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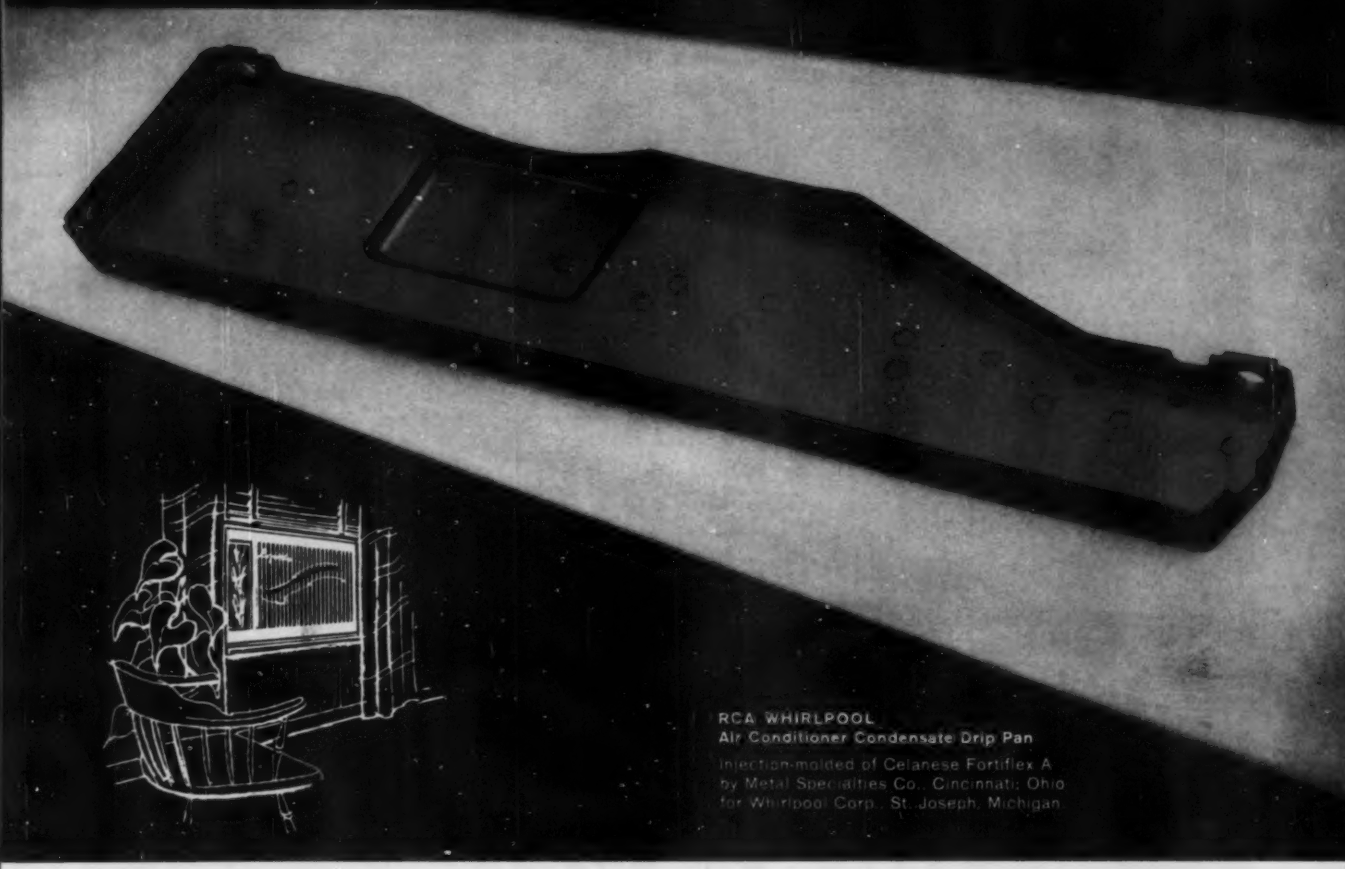
DESIGNED IN CELANESE FORTIFLEX...



Large-area injection moldings cut weight...can't rust

Good part performance dictated the selection of Celanese Fortiflex plastic for this air conditioner drip pan. Fortiflex supplied the toughness for thin-walled, lightweight construction plus corrosion resistance. Fortiflex is unaffected by hot or cold temperatures likely to be encountered in air conditioning systems.

Fortiflex is a designer's material. Five times stiffer than conventional polyethylene, and with superior surface hardness, Fortiflex can help you meet difficult specifications and cost limitations. For more information on this versatile plastic, return coupon below.

Celanese® Fortiflex®

TYPICAL PHYSICAL AND CHEMICAL PROPERTIES OF FORTIFLEX

Properties of Fortiflex "A" Related to Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	FORTIFLEX RESINS A-20	A-70	A-250	A-500
Melt Index	D-1238-52T	—	0.2	0.7	2.5	5.0
Heat Distortion Temp. (66 psi)	D-648-45T	°F.	185	185	180	180
Brittleness Temp.	D-764-52T	°F.	—200	—180	—160	—100
Impact Strength, izod (⅛" x ½" injection-molded bars)	D-256-54T	ft. lb./in. notch	23	18	13	3
Tensile Strength, Max., 0.2 in./min.	D-638-52T	psi.	3700	3600	3500	3300
Elongation, First Tensile Yield Point	D-638-52T	%	25	25	25	25

Properties of Fortiflex "A" Not Affected by Melt Index

PHYSICAL PROPERTIES	ASTM METHOD	UNITS	VALUE
Density		g/cc.	0.96
Refractive Index	D-542-50	n_D^{25}	1.54
Hardness, Shore D	D-676-49T		65
Stiffness	D-747-50	psi.	150,000
Water Absorption (⅛" specimen, 24 hr. immersion @ room temp.)	D-570-54T	%, wgt. gain	<0.01
Flammability	D-635-44	in./min.	1.0
*Mold Shrinkage, length		in./in.	0.03 to 0.05
width		in./in.	0.02 to 0.04

Measured on injection molded tensile bar. Mold shrinkage depends on part design and molding conditions.

Fortiflex...a Celanese plastic

Canadian Affiliate: Canadian Chemical Company Limited, Montreal, Toronto, Vancouver. *Export Sales:* Amcel Co., Inc., and Pan Amcel Co., Inc., 180 Madison Avenue, N. Y. 16.

Celanese Plastics Company, a Division of Celanese Corporation of America
Dept. 101K, 744 Broad Street, Newark 2, N. J.

Please send: ☐ more information on, ☐ test quantities of Fortiflex.

Name ______________________ Title ______________

Company ______________________

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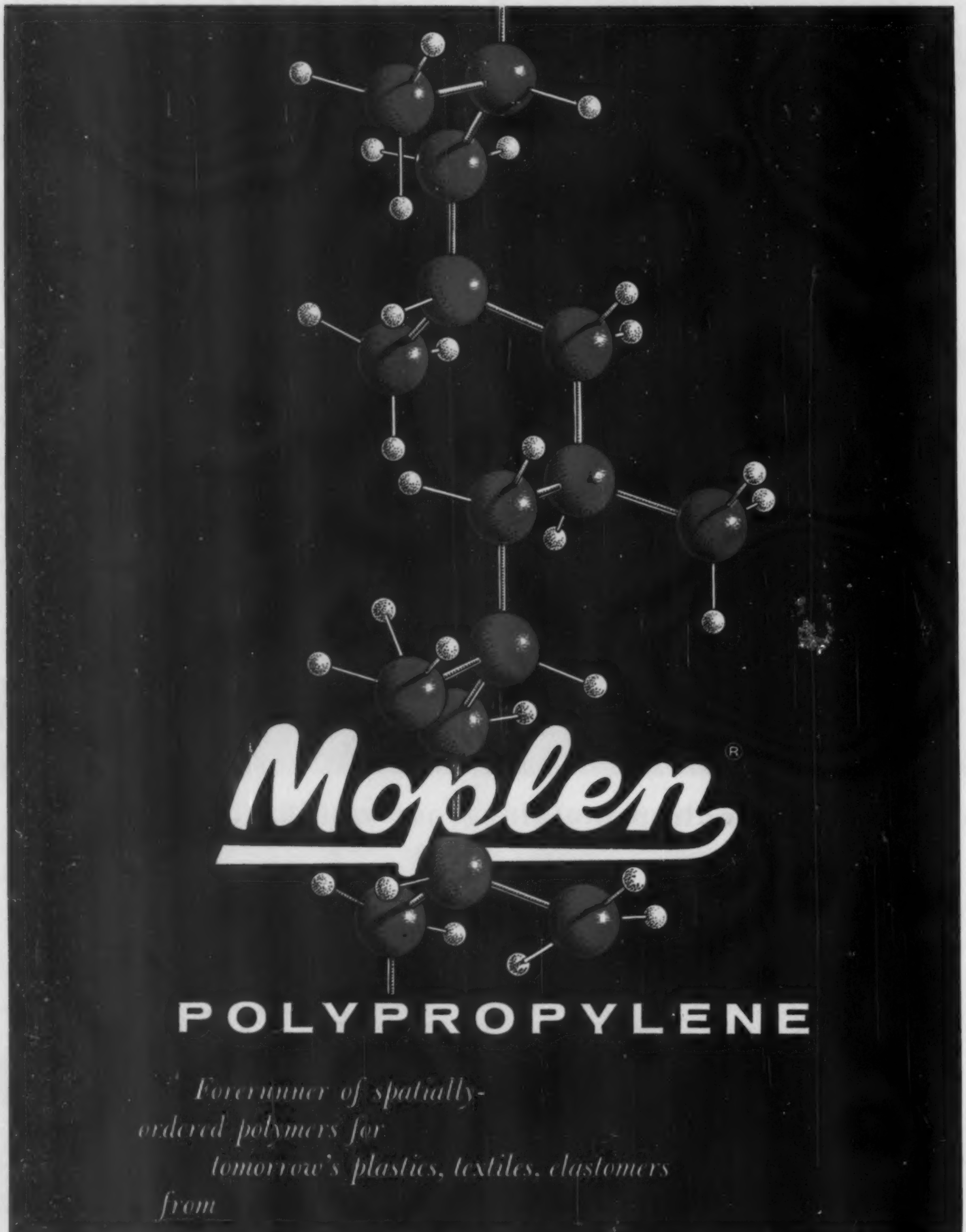
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ordered polymers for
tomorrow's plastics, textiles, elastomers
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Sheets, pipes, profiles, mono-filaments, synthetic bristles, lay-flat film, cast film, embossed plastic sheets, and formed articles direct from the extruded sheet. We also supply equipment for the covering of cable, wire, and all other profiles.

Please contact our representative and discuss your extrusion problems with him.

General view
of a Sheet Manufacturing Plant

Production of blown film;
11'6" wide lay-flat tubing

Extruder S 120
(4 3/4" screw diameter)

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KEITHLEY MODEL 250 STATIC METER

measures static charges on plastic webs

▲

MODEL 250 Static Meter with detector head and cable connected. Instrument has ranges of 10, 30 and 100 kilovolts, accurate within 5%.

CHARGE INTENSITY (in volts) versus problems in processing, packaging or converting equipment for plastic webs. The Static Meter measures potentials up to 100 kilovolts, as well as the voltage span diagrammed. ▶

At last here is an accurate, reliable way to measure static charge voltages. This new Keithley instrument has ready use wherever static charges build up on relatively large surfaces, as on plastics, paper, and hydrocarbons. It is portable, easy to use, and can provide an accurate profile of charge distribution, thus enabling remedial anti-static measures to be applied.

The Model 250 is patterned after a design suggested and used by the Polychemicals Dept., E. I. du Pont de Nemours & Company. The Static Meter is calibrated in kilovolts, with ranges of 10 kilovolts and 30 kilovolts when the detecting head is placed ⅜-inch from the charged surface, with an additional range of 100 kilovolts when operated at a distance of six inches. The system is polarity sensitive and uses a zero-center meter scale.

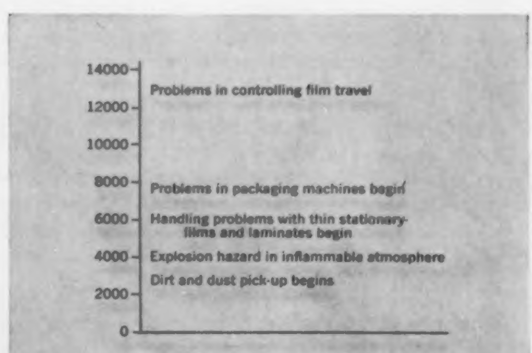
BRIEF SPECIFICATIONS

ACCURACY: within 5% of full scale with correct detecting head spacing. Continuous readings can be made for as long as one minute without affecting the accuracy.

PROTECTIVE FEATURES: plastic rim on detecting head prevents sparking to the head. Shell of detecting head is a ground potential. Instrument circuit is overload-protected.

ACCESSORIES include the Static Detecting Head with cable and grounding wire, and carrying case.

PRICE $325.00



SEND FOR DETAILS ON THE MODEL 250 STATIC METER TODAY

KEITHLEY INSTRUMENTS, INC.
12415 EUCLID AVENUE • CLEVELAND 6, OHIO

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

NOVEMBER, 1959 U. S. Industrial Chemicals Co., Division of National Distillers and Chemical Corporation 99 Park Ave., N. Y. 16, N. Y.

Packaging Notes

A low-cost, semi-automatic bagging machine puts canned and bottled goods in preprinted polyethylene bags to stimulate larger unit sales to the consumer.

A brewery, for example, has increased its sales by replacing its conventional six-pack with an eight-can bagged unit. Quart bottles are bagged in units of three. As an added consumer advantage, the polyethylene bags can be filled with ice to keep the beer cold. The bagging machine can be used to package such canned and bottled products as soft drinks, soups, juices, and dog foods.

A new polyethylene and paper pouch for liquid bleach has been introduced. This disposable pouch for coin laundries holds 2½ ounces of highly corrosive 15% sodium hypochlorite. It is expected to replace the present eight ounce returnable bottles which hold 5% sodium hypochlorite.

The pouch is constructed of paper coated with 3½ mil polyethylene film. A special tear tape at one end permits opening of the package quickly and easily. The package reportedly is lower in cost. It has a shelf-life of six months.

Containers with built-in polyethylene coated paper liners are being used by a frozen foods company to package a portion of its frozen fruits.

Designed to eliminate the conventional overwrap, the new package is said to prevent leakage of the package's contents both before freezing and after defrosting. Liner and carton flaps are automatically sealed, with a combination of polyethylene heat sealing and adhesive.

The new package is more convenient to open than previous metal and fibre cans. Its special interlocking top flaps can easily be ripped off by the consumers without danger of spilling the contents. The new polyethylene lined carton stacks better and provides more printing area. It reportedly has reduced packaging costs and increased packaging speed.

Ralph Knight Appointed Vice President at U.S.I.

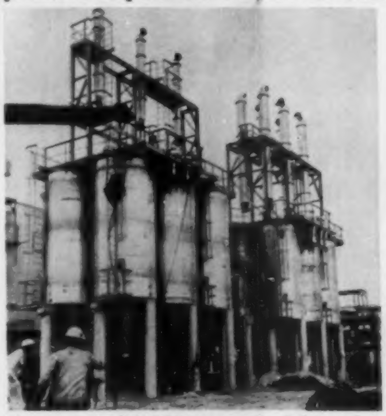
Ralph M. Knight has been appointed a Vice-President at U.S. Industrial Chemicals Co. The new appointment was announced by Dr. Robert Hulse, General Manager of the U.S.I. Division.

Mr. Knight will be responsible for long range planning and coordination of U.S.I.'s polymer development program. He will continue to direct the company's Polymer Service Laboratory as well as coordinate its efforts with other plastic activities in the company. Mr. Knight joined U.S.I. in 1953 as Polyethylene Manager. He is a graduate of Newark College of Engineering.

U.S.I. Plans 50 Million Pound Polyethylene Resin Expansion

Latest Increase Will Make U.S.I. World's Second Largest Producer

U.S.I. has announced plans for a new increase in production capacity of PETROTHENE polyethylene resins — this time 50 million pounds. The planned expansion will be at U.S.I.'s new Houston plant started up in February of this year. This plant, currently being upped from 75 to 150 million pound production per year, will be still further expanded to produce 200 million pounds.



This is part of U.S.I.'s new polyethylene plant located at Houston, Texas, at the time that finishing touches were being made on product silage units last spring. Originally built with an annual capacity of 75 million pounds, the plant is currently being upped to 150 million pounds, will have a final capacity of 200 million pounds, when further expansion is complete next year.

The expansions are expected to be complete by mid-1960, giving U.S.I. an overall production capacity of 300 million pounds annually. This will make the company the second largest among all polyethylene producers in the world.

Growth Has Been Spectacular

U.S.I.'s growth in the polyethylene field has been spectacular. Starting with a production capacity of 26 million pounds in 1955, the company will have realized increase in production of well over 1000% when the expanded facilities go on stream.

Along with this growth has come technical leadership in the field of polyethylene processing, particularly in packaging film. Eighteen months ago, U.S.I. pioneered a new technique for producing crystal-clear cast polyethylene film that is finding extensive application in large volume overwrap and bread wrap markets. While U.S.I. has specialized in low and medium density resins, it has done extensive research work on a new process for making high density polyethylene. The process is said to be superior to any now in use. U.S.I. also is studying the polypropylenes and other polyolefin copolymers in pilot plant operations.

Wide Range of Resins Available

In all, PETROTHENE polyethylenes are available in some 70 different resins, each varying in melt index, density, strength, clarity, gloss, slip, stiffness, and other properties. This wide range of resin properties is a result of U.S.I.'s program of tailor-making resins to meet specific molding and extrusion requirements.

Polyethylene Netting Made With Special Extrusion Die

A new polyethylene netting, extruded from a special reciprocating die, promises to have many decorative and practical applications. The die cross extrudes the polyethylene filaments, welding them together at point of contact while the resin is still molten. The filament junctions are stronger than is possible with heat sealing.

Both decorative and practical applications are foreseen for continuous tubular netting like this which is now being produced.

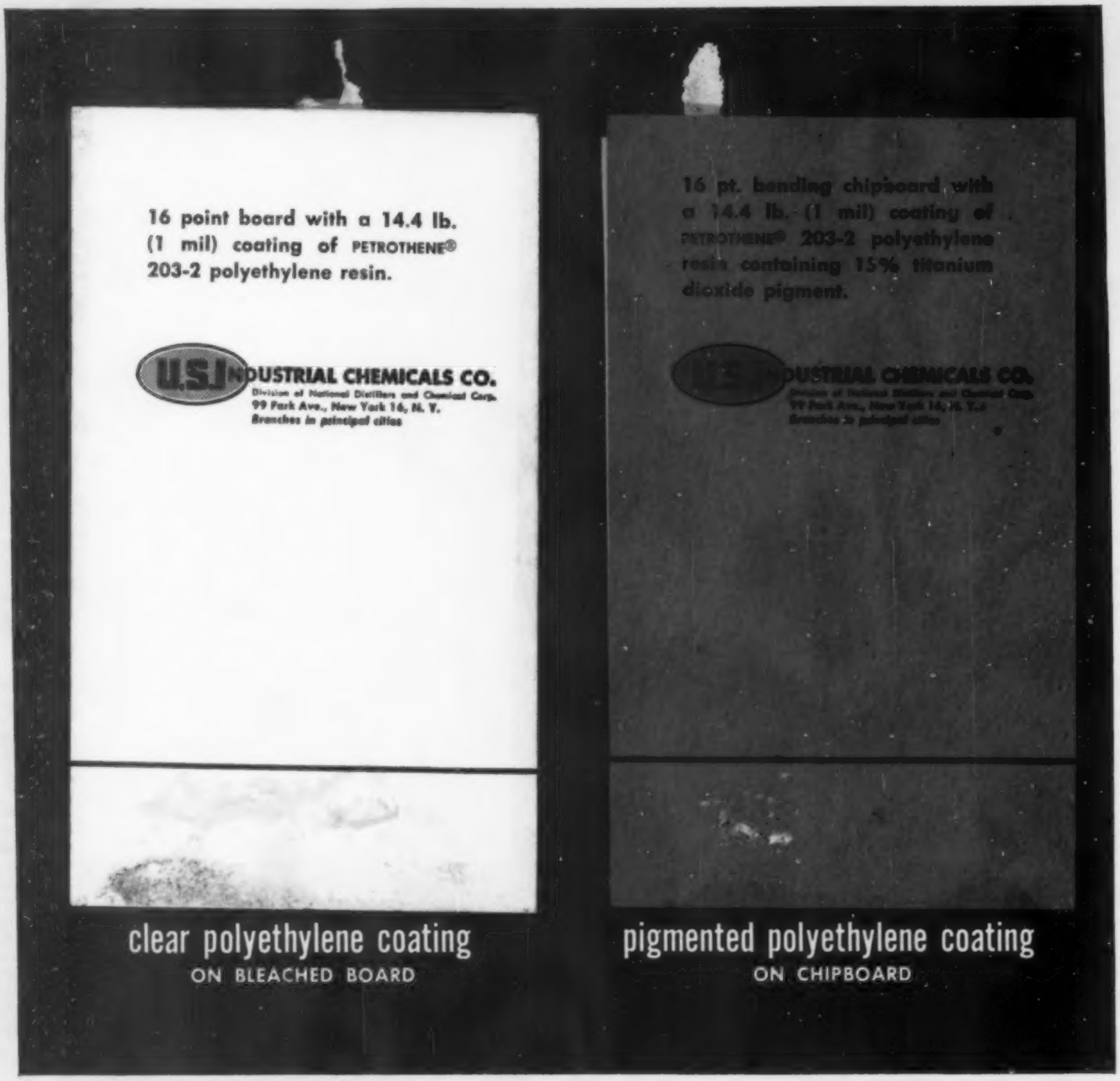
At present the net can be produced in widths up to 36 inches and in tubular form. Multicolored effects can be obtained and the mesh can be varied from very fine to fish-net coarseness.

The manufacturer is now developing an automatic bag machine for packaging vegetables and other produce.

New Ultraviolet Absorber For Polyethylene

A new ultraviolet absorber for polyethylene is currently being evaluated. Thus far, carbon black has been the most commonly used screen for ultraviolet light.

The new compound, if successful, will permit extended outdoor use of clear and colored polyethylene compounds. Field tests have already shown that 10-mil polyethylene film mixed with .171% by weight of the absorber, retained 85% of elongation after two months use in strong sunlight.



THE CHOICE IS UP TO YOU . . .

You know about polyethylene-coated board and the wonderful job it's doing in the food and industrial packaging fields. But do you know about *pigmented* polyethylene coatings and how they can upgrade lower-priced board, allowing you to choose from a wider range of board stock and to achieve even greater flexibility in your choice of packaging materials.

Investigate both kinds of polyethylene coatings; you'll find they're more versatile than ever before.

Clear or pigmented—extruded polyethylene coatings are tough, scuff resistant, unusually adherent. They have superior grease and moisture resistance. They will not scratch other surfaces. They heat seal readily, offer good printability.

Extruders and packagers who make or use polyethylene-coated board may obtain information and technical assistance by writing to U.S.I.

EXTRUDERS—

PETROTHENE® polyethylene extrusion coating resins, manufactured by U.S.I., have good drawdown properties with a minimum of neck-in, give excellent adhesion even down to the thinnest gauges.

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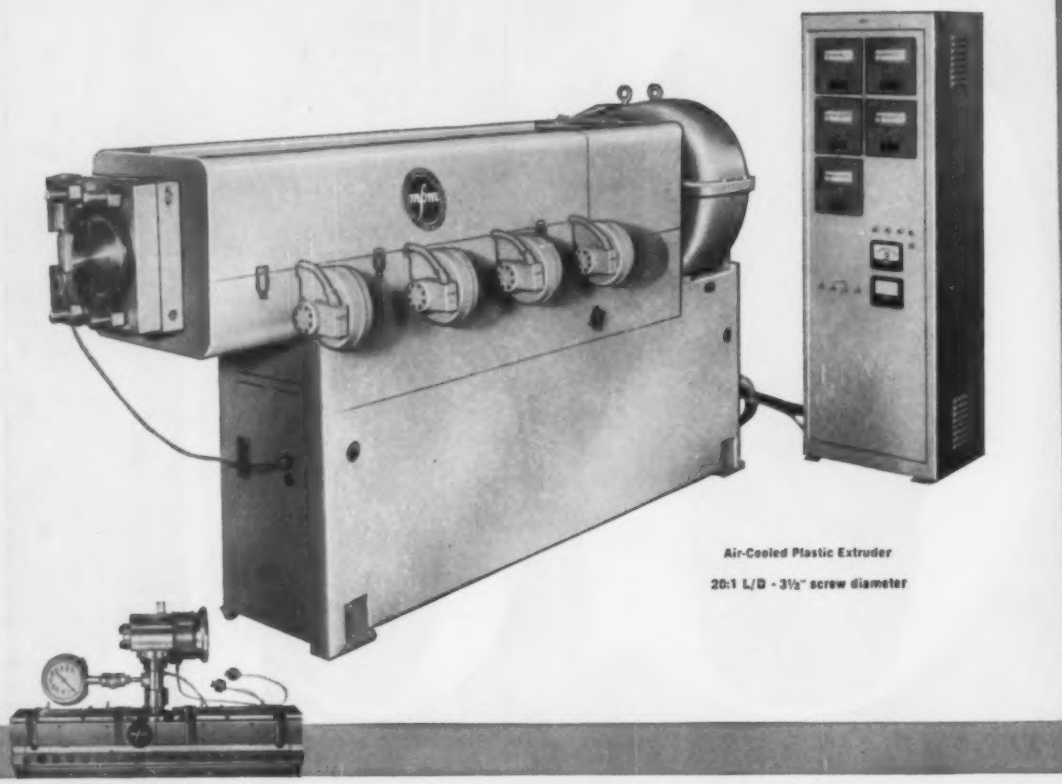
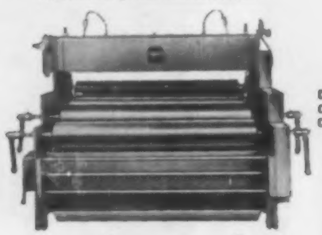


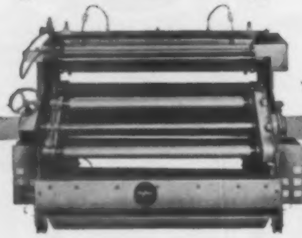
Air-Cooled Plastic Extruder

20:1 L/D - 3½" screw diameter

Laminating or Casting Die with Valve, Pressure Gauge and Thermo-couple



Double Shell Construction Casting Roll Unit



Turret Wind

Outstanding clarity and surface gloss, increased strength, excellent stiffness and slip, narrow variations in gage — these results were achieved with MPM equipment during year-long use by one of the nation's leading producers of polyolefin films.

The accelerated use of polyethylene in flexible packaging indicates a doubling of the market over the next four years. Why not wrap up your sales with **Modern Plastic Machinery.** For complete information and specifications write Fred Maywald.

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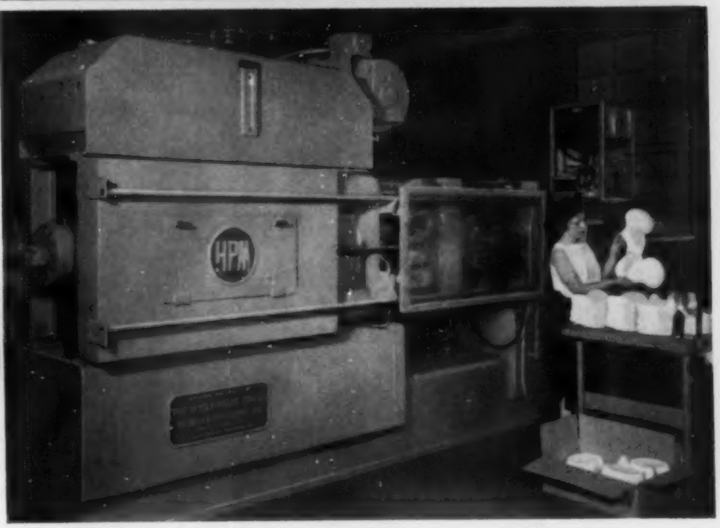
25 East 26th Street, New York 10, N. Y.

59-2

A Pair for Comparison

H-P-M Model 200-H-6/8A injection machine running fully automatic, molding flower pots at Earl Fisher Plastics, Inc., Columbus, Ohio. A versatile, high speed producer for a wide range of jobs.



H-P-M Model 350-HV-12/16 injection machine, molding bicycle seats for The Troxel Mfg. Company of Elyria, Ohio by The General Industries Company, Elyria. This new 12/16" machine is fast, versatile — has all new design for highest production, minimum maintenance.

SPECIFICATIONS	200-H-6/8A	350-HV-12/16
Daylight (in.)	25	34
Daylight with Ejector Box Removed (in.)	29	42
Stroke (in.)	15	22
Clamp Tonnage	200	350
Platen Size (in.)	26x26	34x34
Mold Space (max.)	15x26	20x34
Plasticizing Capacity (lbs/hr.) (general purpose (polystyrene)	90	150
Injection Rate (cu. in. per. min.)	675	1230
Electric Motor (HP)	30	60
Booster Power Units Available To Increase Injection Rate To (cu. in./min.)	1350	2110
Additional HP Required For Booster Power Units	20	30

Here's a pair of money-makers in the wide open 2-oz. to 16 oz. range that will furnish that "one-two punch" for any busy molding plant. These exceptionally fast-cycling H-P-M injection machines have proven themselves in dozens of shops, producing up to 600 shots per hour — consistentiy. They will handle the big percentage of all molding jobs being run today. They're fast, dependable and easily maintained. Your H-P-M field engineer is looking for an opportunity to prove what these machines will do for you. Write or call today for complete information on H-P-M machines for injection, compression, transfer and reinforced plastics molding.

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There's a CIPStown that fits the needs for your new plant. Write, wire or phone our Industrial Department for confidential plant site assistance.

CIPStown business and civic groups seek and welcome participation of newcomers in community projects. Newcomers soon develop that important feeling of "belonging."

Modern schools in CIPStowns have high educational standards . . . emphasize well-rounded development of youth.

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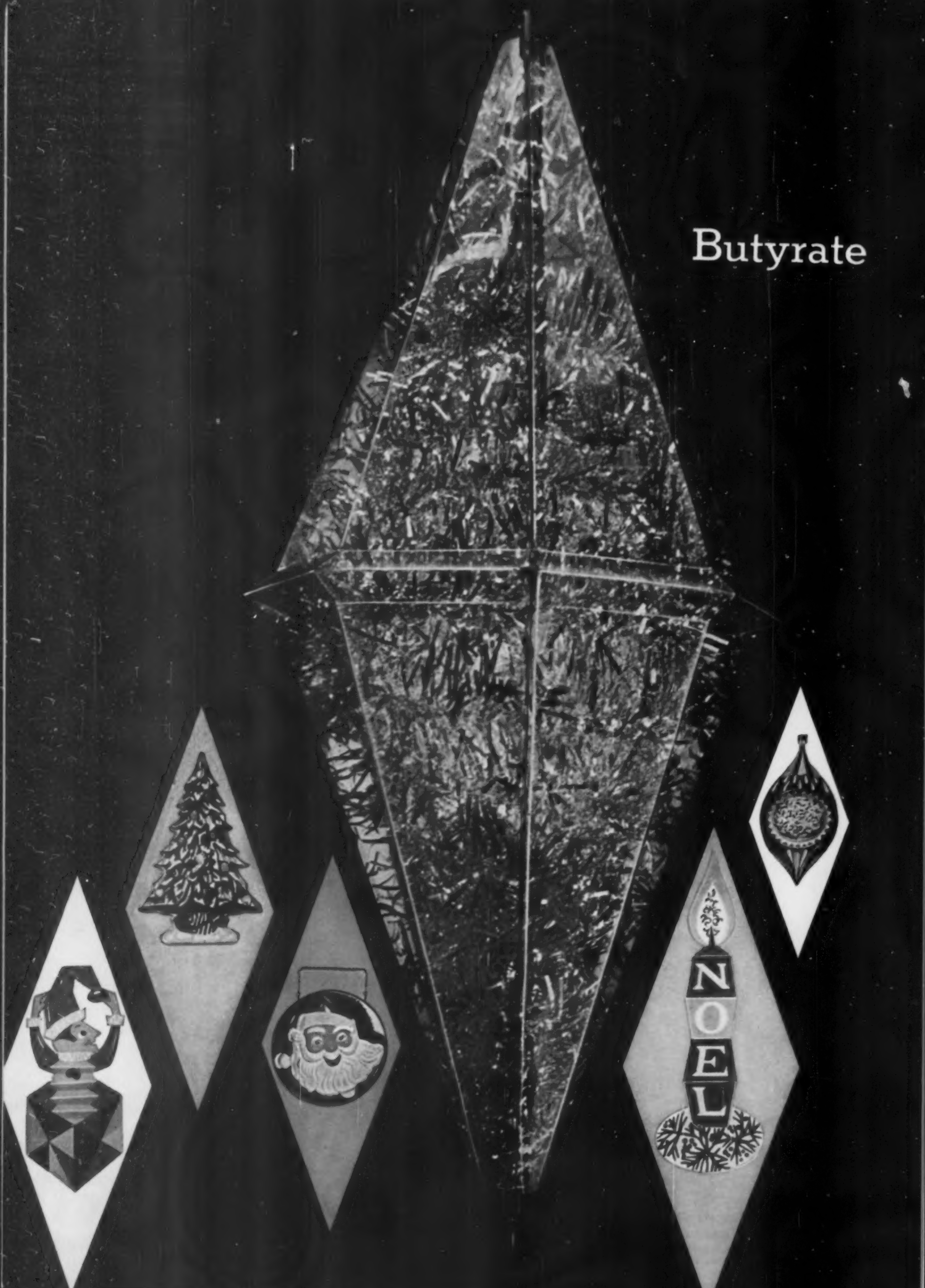
GENERAL OFFICES: ILLINOIS BUILDING, SPRINGFIELD, ILLINOIS


Butyrate
NOEL

gives the gift of long life to giant outdoor Christmas decorations

Street displays made of tough, weather-durable Tenite Butyrate plastic help communities spread Christmas cheer for many years

When you need a plastic with long outdoor life, you find a ready answer in Tenite Butyrate.

Its durability has been proved by displays like these and by hundreds of other applications in many different fields, including such products as automobile taillight lenses, marine buoys, outdoor signs and oil-field pipe.

Yet, the outstanding weatherability of Tenite Butyrate seldom is the sole reason for its use. Rather, it is Butyrate's *combination* of properties that usually dictates its choice for a specific job.

The Christmas decorations shown here are an ideal illustration of how Butyrate's properties can be mated to the demands of a specific use.

Outdoor durability certainly is an important consideration for these decorations. Exposed to weather extremes ranging from sub-zero Alaska to sunny Florida, they must be able to endure in any location, showing excellent resistance to cracking, crazing or "aging."

They must also be tough enough to take the abuse of repeated installation and dismantling, plus the hazards of storing and transporting.

Butyrate satisfies these requirements... and other specifications of the manufacturer, such as availability in a crystal-like, clear-transparent formulation, resistance to yellowing by sunlight, and a high surface luster.

Fabricating advantages, too, complement the service excellence of Butyrate. Because of the ease with which extruded sheet of Butyrate can be vacuum-formed over inexpensive molds on fast-cycle machines, production costs are kept at a minimum. Even decorating costs are low; for the multicolored patterns are applied by silk-screening the inside face of the display before forming, thus protecting the printing from the weather and preserving a naturally glossy exterior. Subsequent fabricating operations such as trimming, punching, stapling, riveting or grommeting are easy to carry out without danger of crazing or cracking.

If you'd like to consider Tenite Butyrate for one of your material needs, let us hear from you. We'll be glad to discuss your application in confidence, and help you evaluate the suitability of Butyrate. For this assistance or for more information, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

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• Molds designed and built in our own shop plus complete engineering service.
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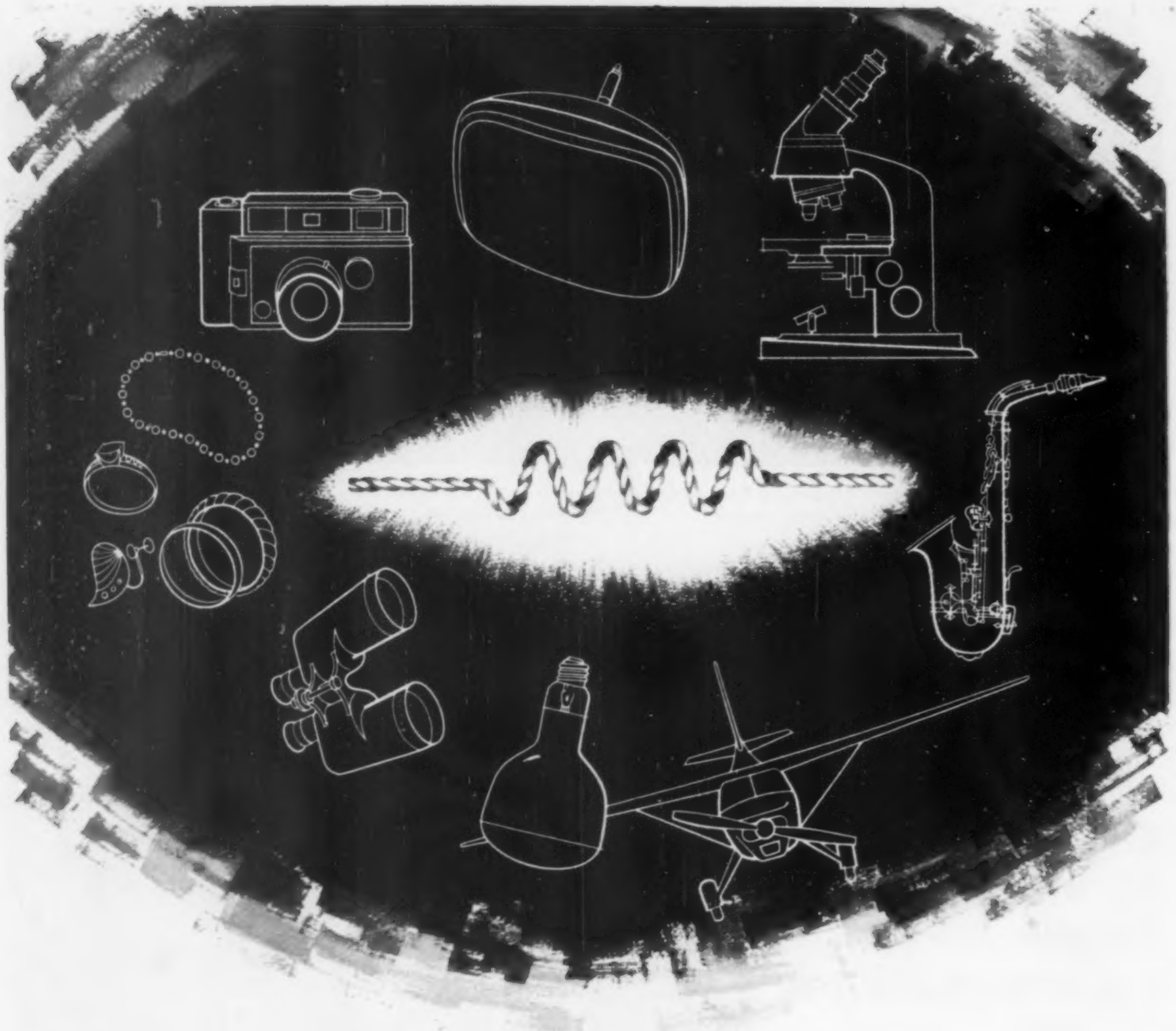

THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 1 — **November 1959**

Impact polystyrene price reduction. A significant price reduction in impact styrenes was announced by Dow last month and quickly followed by other producers. The price is now 28½¢, reduced from 31. The various grades of medium impact were reduced from 1 to 2¢/lb. and now range from 24 to 27 cents. Super high impact is now 41½, was formerly 42½. General purpose remains at 21½, a price which was set last January. Heat resistant GP remains at 21½¢ but light resistant is 23 cents. All these prices are in crystal or natural. VIP color formulations are 1½¢ more than natural when all or part of a 20,000-lb. shipment; or 2¢ more per lb. when they represent part of a shipment that is less than 20,000 pounds.

How will price reduction affect markets? The lower cost of all impact polystyrenes has some interesting connotations. It may have been motivated somewhat by a small amount of price chiseling; but is still surprising since it came at a time when all suppliers were producing and selling at near capacity rates.

The polystyrene molding material story for 1959 is almost an epic. Total consumption in 1959 (including export) is expected to be between 565 and 600 million lb. in contrast to 476 million in 1958—which is a remarkable record for a commodity that many analysts had decided would start to level off a year or so ago. A significant factor in this growth is that more than half, maybe 55%, is impact type material. In any event, a 100- or 150-million-lb. increase in a 400-million-lb. volume commodity is something to crow about.

The new 28½¢ price for natural high impact, compared with 21½¢ for general purpose, lowers the spread between these two main divisions more than ever before. Perhaps the suppliers feel that the radical cut in general purpose last January contributed mightily to increased sales volume and believe that a cut in price of impact materials will similarly broaden the market in impact resins. Furthermore, the resin suppliers may have their eye on competition from the polyolefins and aim to get their prices down before the competition moves in on a large scale. When high impact styrene was 31¢ and high-density polyethylene was reduced to 35¢, the margin was close since the heavier polystyrene requires a 3 or 4¢ differential to meet the volume price of the lighter weight polyethylene. The spread has now been widened again.

An interesting sidelight is that the trend to hard-surface polyolefins in molding as distinguished from soft surface conventional polyethylene has resulted in increased interest in hard surface polystyrenes on the part of many buyers in the industry, a factor upon which polystyrene producers have pounced with great glee.

Shell's polystyrene venture. Shell Chemical Co. and American Cyanamid Co. have reached an agreement to produce polystyrene on a small scale in Cyanamid's Wallingford, Conn. plant, where the latter's Cymac heat-resistant (To page 41)

*Reg. U. S. Pat. Off.

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methylstyrene was once produced. Cyanamid went out of production early in 1959. It is believed that Shell will use the facilities to expand the scope of its polystyrene pilot-plant operations in California, where monomer is produced, and explore more thoroughly the possibilities for commercial production of the polymer. Shell acquired a site for a plastics plant near Burlington, N. J., some time ago but has never announced what will be produced there. Operations in the Wallingford plant may help determine what is to be done at Burlington. Shell is working exclusively with its benzene-type styrene—it is not expected that they will delve into the vinyl-toluene derived styrene from which Cyanamid produced its Cymac methylstyrene material.

Extrusion-forming equipment. A double-wall, impact-styrene coffee cup, expected to compete eventually with polystyrene-foam cups, is now being produced by Foster Grant in limited quantities from a combination extrusion-forming unit. The forming machine is hooked up with the extruder so that the inner and outer shells of the cup are simultaneously formed as soon as they leave the die and then heat sealed around the rim and trimmed. Wall thicknesses of 15 mils seem to be most practical. The same technique can be used to form single-wall cups which, in big-volume production, should compete with the standard plastic-coated paper varieties.

The forming machine is manufactured by Kaberit Spritzgusswerk, Frankenforst, Germany. Foster Grant has an exclusive U. S. license for this particular process and will sub-license others to use it. Kaberit has been producing a variety of containers for some time in Germany but is using general-purpose polystyrene. Foster Grant technicians believe that impact styrene is more practical in the U. S. where rougher treatment is involved and, of course, hope to place this equipment in a number of plants to help promote the sale of impact polystyrene. It is a good guess that Foster Grant is much more interested in selling polystyrene resin for this purpose than in producing containers in its own plant.

DOP to remain tight. Even when the steel strike is settled, DOP plasticizer is likely to remain short for five weeks or more after the mills start operating. Producers claim it will take that long to fill up the pipe lines. As everybody must know by now, napthalene for phtalic anhydride and DOP production is largely a product of the coking operation in steel mills and there has been very little of it around for many weeks. The vinyl chloride industry has been hard hit by this situation in a year which has seen it operating at almost capacity level until recently.

Oriented cast vinyl chloride film. After several years of developmental and experimental work on the project, Reynolds Metals is now marketing a ½- and 1-mil oriented PVC film cast on specially designed equipment in its new plant at Grottoes, Va. The film is designated #527. Chief market so far developed is household wrap where the film is claimed to have superior "cling." The wrap is marketed in rolls of 9- and 12-in. widths with the narrower size suggested for tearing into smaller pieces to serve as can and bowl covers **(To page 43)**

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for the housewife's leftovers. Known as Reynolon, the wrap will be displayed on retail counters alongside the company's aluminum foil so that the customer may purchase both. The company's packaging film is being used for wrapping phonograph record albums and is suggested for bacon, frankfurters, and fresh produce. The oriented films have a tensile strength of about 12,000 p.s.i., compared to 6000 p.s.i. before orienting.

The ½-mil oriented film costs approximately 3.3¢ per 1000 sq. in., or about the same as vinylidene chloride, and is competitive with 300-gage cellophane. The oriented film is, of course, heat shrinkable and for this reason is suggested for bundling—that is wrapping several units in one package. An example would be six cans of baby food in one pack. When the film is shrunk back on such a package it gives a tight, strong wrap. Tensile strength is slightly reduced, but impact and tear strength are greater than before shrinking.

Reynolds is producing solvent-cast vinyl film in thicknesses of from ½ to 6 mils. The non-oriented film is suggested for laminations on paper, board, or other film to provide scuff resistance, and for glazing where its strength, clarity, and weathering are outstanding.

Reynolds new solvent-cast film should not be confused with the company's organosol-cast film, which is used chiefly for finger bandages and kites. One of the keys to the company's success on its project is use of Du Pont's tetrahydrofurane (THF) solvent, plus specially designed equipment.

Vinyl chloride-polyolefin blend. Details concerning a mechanically mixed blend of vinyl chloride and chlorinated polyethylene are now available from Hostachem Corp., New York, N.Y. Hostachem is the American distributor for Farbwerke Hoechst A.G. of Germany, the company which has developed this material and holds patents on same. The new material, which has created considerable curiosity in the United States, is Hostalit Z. It is listed as an impact-resistant PVC, is marketed in white or pastel colors, is thought to be physiologically harmless—and is priced in the 50¢-range depending on formulation.

There are three grades, 720, 840, 870, ranging from rigid to soft—the most rigid for pipe, the medium soft for film, the soft or flexible (which is like normal PVC) for wire coating. The latter is said to minimize the need for plasticizers. The first digit in the number of a formulation signifies the type of resin—thus 7 indicates a compound made from emulsion resin, 8 indicates use of a suspension resin.

Use of chlorinated polyethylene with vinyl chloride is said to offer various advantages. The ratio used varies according to whether a soft or hard compound is desired. Little or no plasticizer is required when the polyethylene-chloride mixture is processed into a finished product so there is no migration or deterioration of electrical properties. It is claimed to have exceptional light and weathering stability and the hard type is said have as good impact as Type II rigid PVC pipe compounds. Its outdoor weatherability is said to be good enough for such products as auto plates (license numbers) and road signs. Heat resistance is practically unaffected by the additional chlorination and the polyethylene which has a plasticizing effect also improves the elasticity of so-called rigid formulations. The working temperature range is wider than was hitherto possible with rigid polyvinyl chloride, and the material will withstand −40° C. before fracturing.

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Broadened distribution—more types, more customers. Cadillac Plastic & Chemical Co., Detroit, Mich., was founded in 1946 as a plastics distributor. In those days there was little for distributors to handle except acetate and methacrylate sheet and rod. The recent addition of a line of nylon 6, (caprolactam) rods, tubes, plates, sheets and massive moldings to their stock calls attention to the broadening variety of plastics materials that can be made available to customers with orders from 25¢ to $10,000 worth.

The company's nylon line now includes both 6 and 6/6 (conventional) types produced in its new extrusion plant in rods and tubes up to 15-in. O.D., plate up to 2-in. thicknesses, and various other sizes. In addition, the company will mold propellers, crank shafts, rudders, and other "massive" items.

Delrin shapes are now also available from the company and cast methacrylate rods and tubes produced in their own plant. Other plastics available are extruded methacrylate, butyrate, Implex modified acrylic (Rohm & Haas), polystyrene, and Cycolac ABS polymer (Marbon) sheets.

New film producer. Arrangements for formation of a new company to manufacture all types of polyolefin films, to be jointly owned by Phillips Petroleum Co. and Joanna Western Mills Co., Chicago, Ill., have been completed. The plant will go into operation in Ladd, Ill., with a capacity of 12 million lb. of film a year. Blown tubing, chill roll, and slot die extrusion methods will all be used. The company will not enter the conversion field.

Sales manager of the new firm, Phillips-Joanna Co., is Robert F. Hrudka, recently of Chippewa. President is F. L. Regnery, also president of Joanna; vice-president is T. L. Cubbage, also vice-president and general manager of Phillips Chemical; vice-president and treasurer is B. F. Stradley, treasurer of Phillips Petroleum Co.; secretary is Harold Johnson, division product manager of Joanna Western.

Initial emphasis will be placed on film made from Phillips high-density Marlex resin that can be used particularly for overwrapping, but there is no intent to limit production to this particular line.

Joanna Western has been prominent in the plastics coating field for many years, especially for production of vinyl window shades, book cloth materials, coated fibers for upholstery, and other types of coatings.

More Implex formulations. Rohm & Haas has added three new grades to its line of Implex high impact methacrylate molding material. The first and toughest formulation, Implex A, was introduced two years ago. It has been particularly successful as a material for molding women's thin-style shoe heels.

The new formulations are Implex B, with greater surface gloss, for quality housings such as electric razors; Implex C, with improved resistance to staining, for piano and organ keys; Implex F, with superior heat resistance, for beverage vending machine canisters. Of these four materials B and C have the greatest flow in thin sections. Specific gravity varies from 1.12 for A to 1.18 for C—heat distortion from 185° F. for B and C to 207° F. for F at 66 p.s.i. Cost in quantity lots is 56¢ per pound.

For additional and more detailed news see Section 2, starting on p. 214

LETTERS TO MODERN PLASTICS

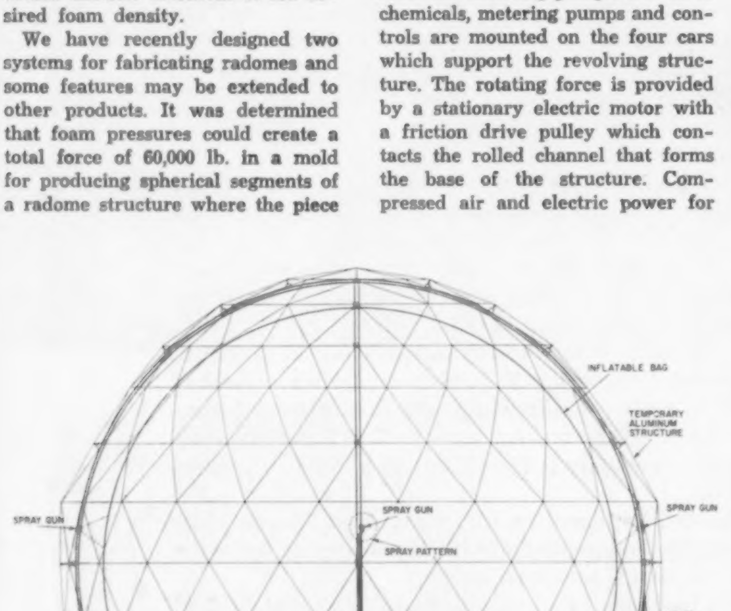
Where readers may voice their opinions on any phase of the plastics industries. The editors take no responsibility for opinions expressed.

Ingenuity in urethane

Sir: A promising urethane foam application technique for general use is a mixing-spraying process now being investigated for many applications ranging from pre-fab housing insulation to coating of textiles, or, in sandwiching urethane foam between kraft paper liners as a replacement for corrugated cardboard in applications where exposed to wetting. However, spray applications have their own particular problems and special procedures are necessary to minimize sag and to obtain uniform thickness at the desired foam density.

We have recently designed two systems for fabricating radomes and some features may be extended to other products. It was determined that foam pressures could create a total force of 60,000 lb. in a mold for producing spherical segments of a radome structure where the piece is approximately 9 ft. by 9 ft. of 4-in. thick rigid urethane foam having a density of about 18 lb. per cu. foot. The cost of conventional metal or reinforced epoxy molds was excessive. Reinforced concrete molds proved a relatively inexpensive arrangement and the foam making equipment was carried to each of the molds in contrast with the more conventional method of passing molds underneath a stationary foam dispensing unit.

In another system for producing a complete radome in one piece by spray coating a removable inflated bag, a truncated spherical structure was designed to mount four spray units which sprayed the bag as the structure was revolved. The sketch below shows a 60-ft. diameter structure of bolted aluminum tubing which rotates about a stationary inflated bag while four mixing spraying units are automatically moved toward the apex along a track formed from curved channel sections. These channels also carry the cables which elevate the mixer-spray units and, in addition, support the hoses which supply chemicals from the metering pumps. Drums of chemicals, metering pumps and controls are mounted on the four cars which support the revolving structure. The rotating force is provided by a stationary electric motor with a friction drive pulley which contacts the rolled channel that forms the base of the structure. Compressed air and electric power for the metering units are supplied from stationary units that are connected to the revolving structure through swivel joints at the apex of the bag. A bolted construction is used so that the structure can readily be dismounted after the foam has been put in place.



Although strong enough to carry the weight of a man, should difficulties develop, the structure is light in weight and all pieces can be transported by plane.

Walter D. Voelker, Pres.
Urethane Systems Engineering Inc.
Philadelphia, Pa.

Macy's tells everybody

Sir: I was very interested in reading in MODERN PLASTICS for October (Plastiscope, p. 41) where Macy's in New York City installed an injection molding machine in its basement to produce high-density polyethylene mixing bowls right in front of the customers' eyes.

I believe your readers may also be interested in the unique animated display (see photo, above) which was first shown in a Macy's window, and is now on tour in leading department stores across the U. S.

The display features the unbreakable bottle which we blow-molded from high-density polyethylene as a container for "Children Shampoo," a new product of John H. Breck Inc., Springfield, Mass.

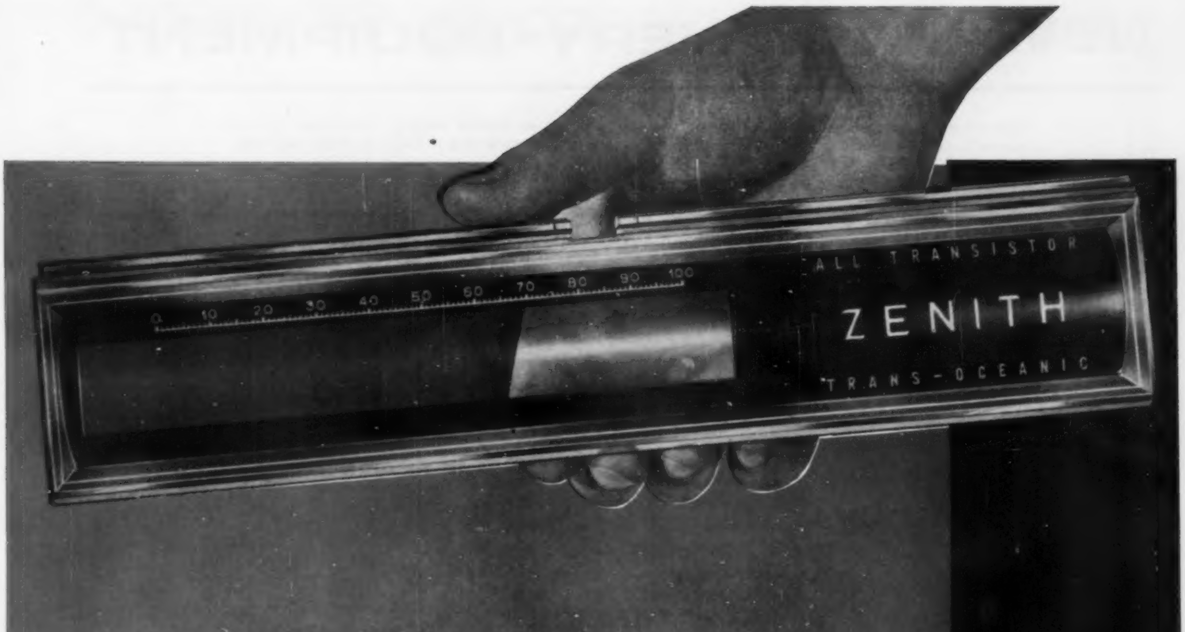
We at Plax Corp. see the two Macy's displays as significant steps toward complete consumer acceptance of PE in the manufacture of bottles and other containers for a wide variety of consumer goods.

If Macy's does not tell Gimbels, it surely does—by displays such as these two—tell the world that it has faith in the product and implicitly urges them to share that faith.

With such encouraging support from the retail trade, molders can, we believe, look ahead confidently to ever-increasing applications of high quality plastics by manufacturers of consumer goods.

Oke R. Henstrand, Mgr.,
Advertising & Sales Promotion
Plax Corp.
Hartford, Conn.

Editor's note: For what is already being done in blow molding today, see our lead article starting on p. 83 of this issue.



One-piece 4-purpose plastic part designed by Zenith... molded economically to highest specs by ERIE

ERIE-*nomics at work . . .*

This one-piece plastic part designed by Zenith® for their "Trans-Oceanic"® Portable Radio is formed all at one shot by Erie's Plastic Division as an ERIE-nomical molding.

The clear plastic area magnifies where dial numbers must be read. The attractive name-plate is molded in colorful 3-dimension. And the "metal" frame is actually molded plastic that is metallized.

Zenith designers reduced assembly operations to a minimum by using this single ERIE-nomic molded part instead of multiple assemblies. At Zenith, they merely put this complete piece in position, fasten it with push-on fasteners, and the job is done . . . better, easier, at lower cost.

ERIE PLASTICS

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Andover, Ohio

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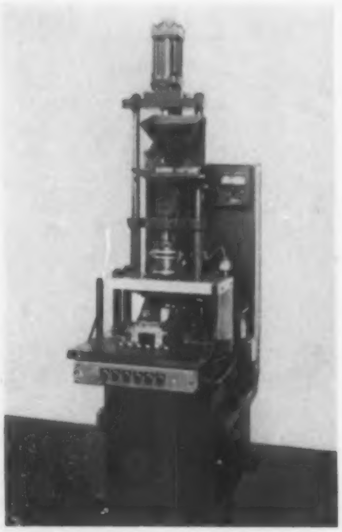
Write today for an informative booklet about ERIE PLASTICS services. Tell us when you would like to see our ERIE PLASTICS man.

NEW MACHINERY-EQUIPMENT

Specifications, claims made, and prices appearing in these pages, are those of the manufacturers or sellers of the machinery and equipment described, or their agents.*

Vertical injection machines

Two machines of 1-oz. (VMM-1) and 2-oz. (VMM-2) capacities have been developed for insert, contact, and plug molding. Both machines are equipped with a push-button operated sliding mold table which allows the operator to pull the mold out from between the platens for easy insert loading. Electrical interlocks prevent the loading of inserts unless the table is in the out position. Cylinders can be switched for color-change simply by removing two screws, replacing the cylinder, and tightening the screws. Dry run production rate is 600 cycles per hour. Machines are delivered ready for operation after power and water connections are made. *Progressive Tool & Die Co., 530 Boston Turnpike, Shrewsbury, Mass.*



PROGRESSIVE VMM-1 1-oz. vertical injection machine is designed for molding thermoplastic parts with inserts.

Mold protector

Circuit-Master Automold automatically stops an injection molding machine from applying clamp pressure when dies are not closing properly. The control receives information from a pressure sensor fastened to the die cylinder and a position sensor mounted on the mold. Whenever the die cylinder's hydraulic pressure exceeds a pre-determined setting due to a misalignment of die pins, lack of lubrication, foreign matter lodged in the molds, or other malfunction, Automold automatically stops and reverses the die piston's forward motion and opens the mold. Completely self-adjusting the unit automatically compensates for expansions due to temperatures and mechanical changes. *Wintriss Inc., 20 Vandam St., N. Y. 13, N. Y.*

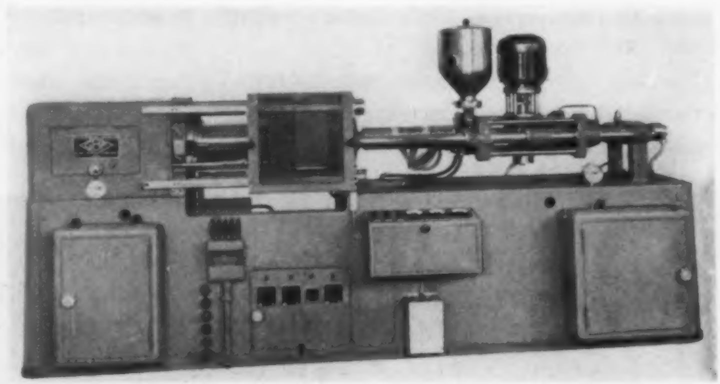
Valve for viscous fluids

The Gear-Vac valve is essentially a gear pump and valve combined. Suitable for handling small flows of viscous liquids, such as plastisols, polyester, and acrylic resins, the valve can be either manually-operated by a handwheel or motor driven. These valves, instead of restricting passage of media, develop increased flows by increasing the r.p.m. (or distance of travel, for measured slugs), of the gear mechanism. When the gear mechanism is not turning, the flow of media is shut-off as positively as in any conventional valve. Because a positive pumping action is developed when the gears are rotated, flow starts immediately and tanks of viscous materials can be emptied faster than with gravity flow alone. The valves may be also used for material dispensing with an accuracy of ±2 per cent. *Eco Engineering Co., 12 New York Ave., Newark 1, N. J.*

GEAR-VAC valve uses gear pump principle to start flow of viscous liquids.

Injection machine

The Plastiniector line of automatic injection machines uses an unusual ram design for preplastication and injection. The ram is similar to an extrusion screw. Between shots the rotating ram mixes and plasticates the material. For injection the piston screw (while still rotating) operates as does the conventional ram. Because of the screw action, the machine has the advantage of more uniform plastication and maximum thermal efficiency. Machines are available in several sizes from 2 to 20 oz. (polystyrene). The largest, (Model V-504), has **(To page 50)**



PLASTINIECTOR injection machines use a rotating screw for preplastication, which also doubles as the injection ram. This is the 8-oz. machine. The line is distributed in U.S. by The Rainville Co. Inc.

* Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models, and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

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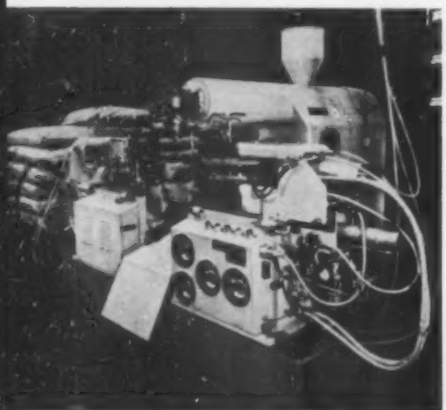
a plasticating capacity of about 340 lb./hr. and a delivery of 30 cu. in. per stroke. This press has a 270-ton clamp and will accommodate molds up to 28 by 24½ in.; maximum daylight between platens is 27½ inches. The main drive motor is 20 hp., and the screw motor is 2½ hp. *Covema s. r. l., Via Fontana 5, Milan, Italy.* Distributed in the U. S. by *The Rainville Co. Inc., 657 Franklin Ave., Garden City, N. Y.*, and *1420 S. Garfield Ave., Alhambra, Calif.*

Bottle blow-molding unit

Granbull-Newark machine operates with any extruder which is equipped to vertically feed a tube of molten plastic to the blowing



GRANBULL-NEWARK blow-molding units (2) are shown installed for operation from a single outlet extrusion head.

mold. Each blowing unit is capable of complete automatic operation. When two blowing stations are desired, two units can be synchronized for dual automatic operation from either a single or double outlet extrusion manifold. Cycle sequence is as follows: tube is extruded, mold closes on tube cutting off and blowing object, mold ejects blown article and moves forward for next cycle. All movements are air operated with valves actuated by solenoids and controlled by electrical timing circuits. Maximum bottle size is a 50-oz. square or 40-oz. round bottle. Typical production rates from two synchronized blowing units fed by a 2-in. extruder producing 50 lb./hr. with a single extrusion head, are 900-4-oz. bottle/hr. or 240-40-oz. bottles/hr. Units require 60 to 80 p.s.i. air and two units consume air at a rate of 40 cu. ft./min. *The Granbull Tool Co. Ltd., 39 High St., Kingston-on-Thames, Surrey, England.* Available in the U. S. through a license arrangement with *Newark Die Co., 22 Scott St., Newark, N. J.*

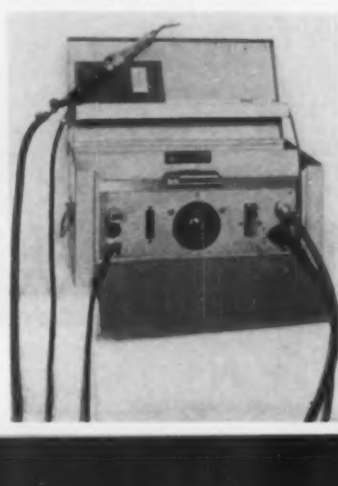
Film perforator

Round hole perforator machine for polyethylene, cellophane, Mylar, and other films and paper, requires only 1 ft. of floor space parallel to the web material. The unit operates at press speeds, and can be set up to punch any of the following hole sizes: $\frac{3}{32}$, $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ inch. Unit can handle web widths of 30, 36, and 42 in., or can be adapted for other widths as required. A side adjustment for centering with the web is provided and the spacing of individual sets of punch and die wheels is adjustable across the web. Continuous rotary motion, an anti-backlash driving gear, and staggered position of punches and dies assure smooth, quiet operation. Other features include spring loaded, adjustable pressure punches; adjustable, reversible, and regrindable dies. *Laukhuff-Pratt Mfg. Co., 3095 W. Mill Rd., Milwaukee, Wis.*

Gas welder

Model 3-TE hot air welding kit is a completely self-contained unit designed for laboratory or continuous production use. The kit is equipped with a 400-w., 18-in. long electric air torch with a maximum operating temperature of 700° F. Controls are permanently mounted and consist of a powerstat voltage control, flow meter and air control valve, thermometer, and a line breaker switch. Air and gas fittings are of the quick disconnect type. The unit comes with three nozzles, a 10-ft. air hose, a 10-ft. power cord, cabinet, service wrench, and instruction pamphlet. Power needed is 115 v. a.c. 400-w. supply. Ready for use upon delivery. *Plastic Welding Corp., 780 Frelinghuysen Ave., Newark 12, N. J.*

PLASTIC WELDING Model 3-TE kit, showing controls and hot air torch attached to the complete unit.



Blown film package

Designed for production of both polyethylene and plasticized vinyl layflat film, the D-S blown film

DAVIS-STANDARD layflat film production package consists of equipment as shown.

setup includes the Thermatic extruder, an air ring, a cross-head-type die, and film tower. The air ring has internal baffling for even air distribution, as well as water cooling coils for proper air temperature control. Rotative crosshead dies eliminate "weld marks" or "knit lines." Uniform flow of material is assured by a rotative core tube holder. This even-flow pattern controls gage and eliminates decomposition of materials such as PVC due to dead spots in the head. The tower is adjustable in height from 14 to 18 feet. Nip rolls on the tower are powered by a variable speed motor and have constant-bleeder-type air controlled pressure. One of the rolls is chrome plated, the other is rubber covered; both are drilled for water cooling. Lead rolls are furnished. Film treaters, static eliminators, slitters and wind-ups are available as optional equipment. *Davis-Standard, Mystic, Conn.*

Electric melter

Simplified hot-melt-adhesive melter AD24SS performs two functions in a single unit. The upper section is designed for freeing melt adhesives from 50- and 100-lb. drums; the lower section is used for completely melting down the adhesive. The units are designed for **(To page 52)**

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temperatures of 150 to 450° F. and are suitable for lab or production work. The inner tank is made of stainless steel—16 in. in diam. by 28 in. deep—with a flat bottom and inside legs to support an upturned can of adhesive. Two separate electric heating zones draw a total of 5.3 kilowatts. Temperature of each zone is controlled by thermostats, and a thermometer is so installed to indicate the temperature of the melt. A swing gate SS valve for viscous materials dispenses the adhesive. *Sta-Warm Electric Co., Ravenna, Ohio.*

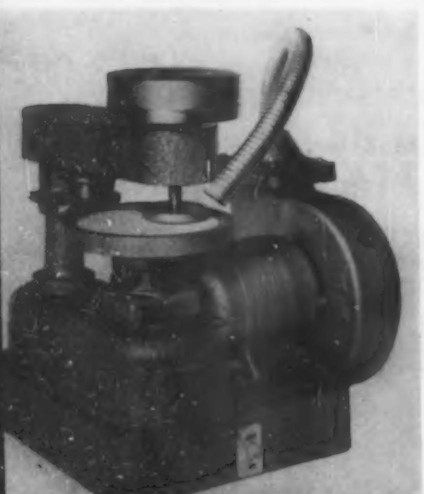
Hand trucks

Known as the Kennett Unilevel truck, this "floating bottom" hand truck can be used for inplant distribution of plastic parts and subassemblies. The new device facilitates loading and unloading by keeping the truck contents at waist level continually at the top of the truck. This is accomplished by the "floating," hardwood bottom mounted on heavy-duty torsion springs which permit the bottom to move up or down depending on the weight of the contents. Unilevel trucks are available for handling various types of loads up to 450 pounds. *National Vulcanized Fibre Co., 1059 Beech St., Wilmington 99, Del.*

Abrasion tester

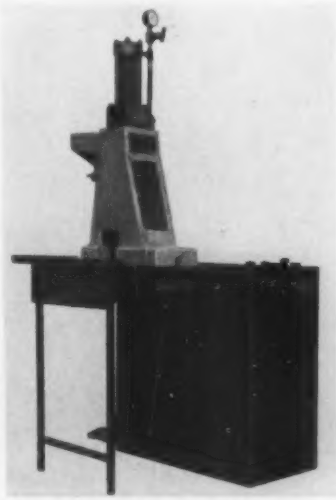
Based on a mathematically devised principle, the rub tester is so designed as to provide uniform rubbing in all directions over the whole surface of the upper, smaller test disk. Various dead loads can be applied to the disks to simulate various abrasion conditions. The machine is equipped with a revolution counter and a fan which provides an air blast through a flexible hose for removal of dust from the rubbing surfaces. The disks are chain driven by a 230 to 250 v., 50 c.p.s. single phase A.C. geared electric motor. *Testing Machines Inc. 72 Jericho Turnpike, Mineola, N. Y.*

TESTING MACHINES abrasion tester illustrating the arrangement of the rotating disks for uniform abrasion in all directions.



Small injection press

The new Super "Wasp" Mini-jector ¾ oz. injection molding machine has been designed so that all controls are in easy reach of an operator seated at the machine. As with other Mini-jector presses, a standard self-clamping, wedge-shaped "V" mold is used. Since molds are usually small, they can be loaded and unloaded manually. Standard equipment on the new machine includes a 2½-in. hydraulic injection cylinder and a 2-hp. 220/440 3-phase 60 cycle a.c. motor and starter. Injection pressures as high as 30,000 p.s.i. can be developed. Machine is also equipped with an automatic air-jet mold ejector; timer for semi-automatic cycling; and temperature control to ± 1° F. About $2400. *Foster & Davies Inc., Keith Bldg., Cleveland, Ohio.*



WASP MINI-JECTOR has all controls within easy reach of seated operator.

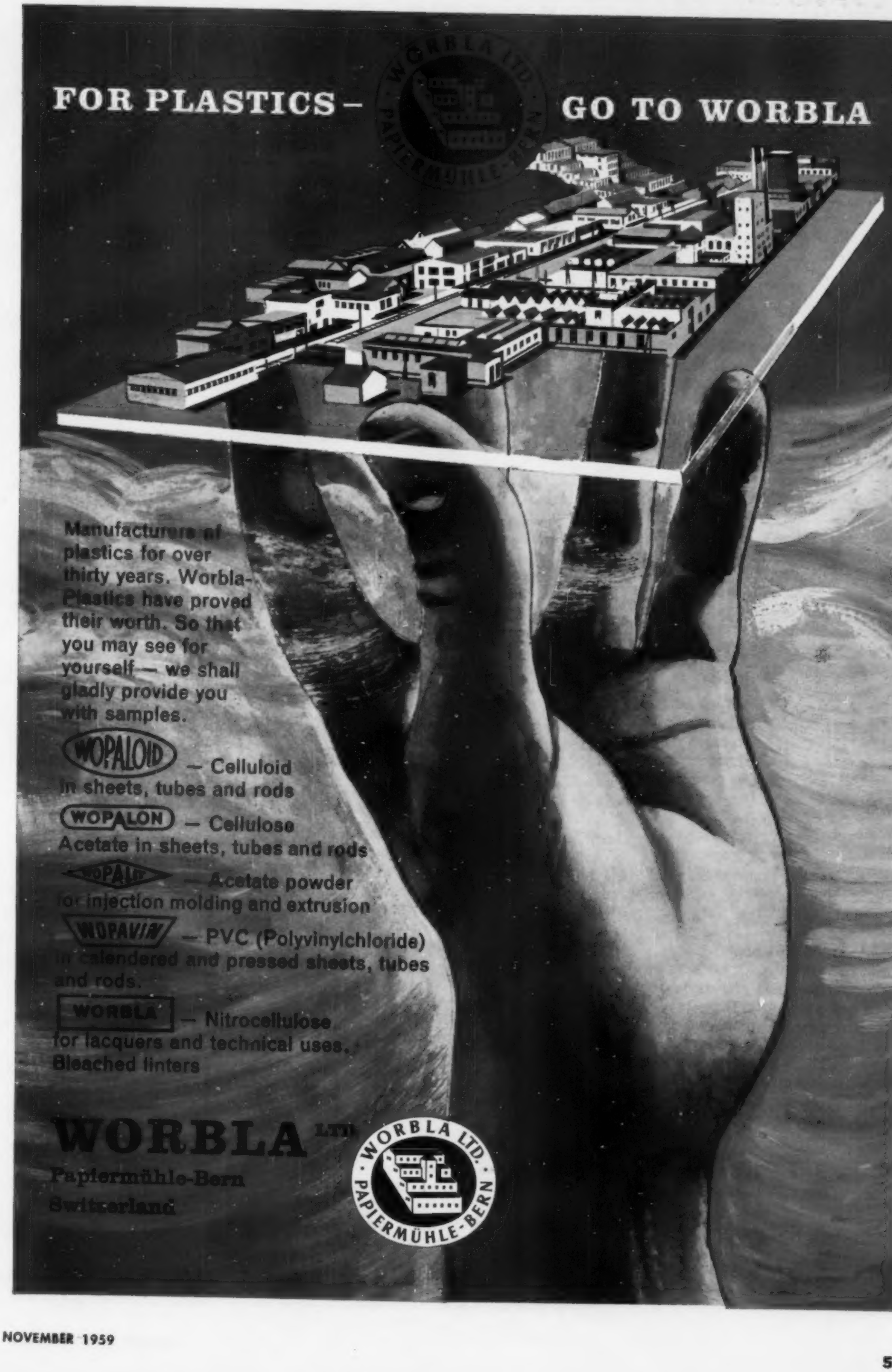
Thermoforming machine

Di-Acro Model 18A is suitable for experimental or short production runs in stretch, vacuum, or blow forming operations. Skin and blister packaging operations can also be performed. The press is a self contained unit complete with a motor driven vacuum-pressure pump. Platen rides on four guide posts and is raised or lowered by screw action on the center column. Sheets up to 18 in. sq. can be formed and the press has a maximum draw of 8 inches. A pivot mounted radiant heater panel delivers a maximum temperature of 660° F. and is adequate for fast cycles with most thermoplastics. Also included with the machine is a hinged clamp frame for inserting and removing plastic sheet materials. Price $845 f.o.b. manufacturer's plant. Delivery about 4 weeks. *O'Neil-Irwin Mfg. Co., 578 8th Ave., Lake City, Minn.*

DI-ACRO Model 18-A thermoforming press is designed for experimental or short run production work.

Screen printer

The Markem Model 112S screen process printer is designed to give maximum ink coverage and uniformity of entire imprints along with accurate registration of all colors in a multi-color imprint. It will mark objects (such as children's boots, containers, toys) up to 23 in. square, with a maximum imprint of 12 by 12 inches. A dual ink squeegee assures best uniformity, and a flood stroke, when desired, gives more opaque coverage. Up to 20 pieces per minute can be printed. The machine is air-operated, using 60-p.s.i. air and electrically controlled. Accessories are also available. *Markem Machine Co., Keene 80, N. H.*—**End**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WORLD-WIDE PLASTICS DIGEST

Abstracts from the world's literature relative to plastics. For complete articles, send requests direct to publishers. List of addresses is at end of this section.

General

Polyolefins—today and tomorrow J. C. Swallow. Plastics (London) *24*, 203-6 (June 1959). The technical and economic developments over the past 25 years in the field of polyolefins are reviewed. Various aspects of these developments and their impact on the economy of many nations throughout the world are surveyed. Some of the factors that influenced the growth rate of both low- and high-density polyethylene and polypropylene are discussed.

Rugged new polymers sought. Chem. Eng. News *37*, 40 (Aug. 3, 1959). Polymers that contain atoms other than carbon in the main chain and fluorinated polymers are discussed.

Plastic foams—future trends and markets. R. N. Kennedy and W. C. Goggin. Rubber and Plastics Age *40*, 250-53, 255 (Mar. 1959). Properties and applications of plastic foams are discussed. Particular attention is given to applications that are applicable in the building industry.

Locating the market for plastics products. J. M. Gould. Plastics Tech. *5*, 43-48 (July 1959). Information on the location of and employment in factories producing plastics products are reported. Some figures on production are also given.

Materials

Barium-cadmium stabilization of PVC. N. L. Perry, Rubber Age *85*, 449-52 (June 1959). The historical developments leading to the discovery and use of barium-cadmium stabilizer systems in clear, calendering stock compositions of polyvinyl chloride are presented. These systems impart many desirable properties to the finished film. They are compatible with epoxy-type stabilizers and help overcome some of the difficulties encountered in the use of epoxy systems alone, while retaining the temperature-resistant features. The influence of vinyl resin contaminants on the stabilizer systems, the various components of the systems, and their stability in end use products are discussed.

Use of clays in vinyl compounds. E. W. Schwartz. Plastics Tech. *5*, 31-34, 42, 49 (July 1959). Clays are used as fillers in rubbers and plastics. Formulations of vinyl chloride plastics containing clays are given and their properties reported.

Polymer-coated polystyrene. H. A. Scopp and S. Black. Modern Packaging *32*, 116-18 (July 1959). A 0.1-mil polymer coating applied to biaxially oriented polystyrene (PS) film is said to produce a more useful packaging film. Abrasion resistance, transmission rates, and resistance to fogging and to grease are superior to similar properties for uncoated PS. Transmission rates for water vapor are reduced by 30 to 50%. Gas permeability rates are exceptionally low, particularly for the thinner gages. The hydrophilic nature of the coating reduces fogging and increases grease resistance.

Vulkene, chemically cross-linked Polyethylene. A. R. Lee and J. E. Vostovich. Rubber World *140*, 429-34 (June 1959). Dicumyl peroxide is used as a crosslinking agent for polyethlene (PE). This peroxide is stable at normal milling temperatures, and does not decompose until subjected to steam pressure processes after extrusion. Consequently, the handling characteristics of the PE molding compounds are unchanged, but the molded material exhibits properties superior to those of low-density PE. The crosslinked plastic is said to be more resistant to chemicals, ozone, and weathering, and to have higher tensile strength, impact strength, and abrasion resistance. Thermal properties are excellent. Continuous service at 75° C. is practical and the tensile strength at 150° C. is 500 p.s.i.

Temperature zones improve polymers. Chem. Eng. *14*, 76-78 (July 13, 1959). A continuous polymerization process has virtually eliminated lot-to-lot variations in nylon-6 molding and extrusion resins. This is achieved with a polymerizer configuration that permits zone control of temperature. The continuous process basically follows the same chemistry as the batch process. Caprolactum is opened by heat and catalyst to form ε-aminocaproic acid. The amino acid is then polycondensed into a linear chain polymer, nylon 6. The length of the chain is determined by the type of catalyst and operating conditions. To carry out the reactions continuously, four distinct reaction-temperature zones are maintained in a single vertical polymerization unit.

Flame-resistant glass-polyester laminates. H. R. Sheppard. Electrical Mfg. *64*, 122-24 (July 1959). Under extreme conditions a circuit breaker may be exposed to a power-arc and catch fire. Flame-resistant glass-polyester laminates that are self-extinguishing have been developed. This has been accomplished with chlorine-containing polymers and the addition of fillers such as antimony oxide which reacts with chlorine to form antimony chloride, an extinguishing agent. The tests for tracking under adverse conditions are described and data that is available for several glass-polyester laminate systems given.

Molding and fabricating

Ten years progress in mill design. J. B. Young. Rubber and Plastics Age *39*, 1058-60 (Dec. 1958). Developments in the last 10 years in rubber and plastic milling equipment are reviewed.

VFH preheating for thermosetting molding. J. F. Trembley. SPE J. *15*, 543-45 (July 1959). Improved design of electronic preheaters, particularly in the 70 to 100 megacycle range, yields faster production cycles in the molding of plastics compounds. Preheating in the range of 270 to 300° F. reduces both the preheating and the molding cycles. Higher mold temperatures may be used since cure time is reduced and degradation is less apt to occur. Materials of lower flow may also be substituted to reduce curing times. The new equipment is applicable for use in automatic molding of loose material as well as of preforms.

Applications

Alloyed plastics give oilless bearings. H. C. Mellor. Prod. Eng. *30*, 58-60 (May 25, 1959). An impregnated-plastic bearing is described which can operate for prolonged periods at fairly high loads or temperatures and without need for lubrication. The bearing material is a mixture of several plastics blended with both synthetic dry and viscous lubricants. It will not cold-flow or **(To page 56)**

(*From page 54*)

melt. One plastic acts as a reservoir for synthetic viscous lubricants. A second increases the thermal conductivity dissipating heat to the bearing housing. A thermosetting resin holds the masses together.

Allowable working stress in rigid PVC pipes. A. A. van der Wal. Rubber and Plastics Age *40*, 156-58 (Feb. 1959). The factors involved in setting a working stress for pipe made of PVC plastics are considered. It is concluded that a circumferential tensile stress of 80 kg. cm^2 (1,140 p.s.i.) is reasonable.

Isopolyesters join the maintenance team. Chem. Week *85*, 31-32, 35-35 (Aug. 8, 1959). Glass-fiber-reinforced isopolyester plastics are used to repair tanks, valves, and tubing in chemical plant equipment. Information on costs is presented.

The nonwoven fabrics industry. Ind. Eng. Chem. *51*, 902-12 (Aug. 1959). Six papers on the properties and structure of nonwoven fabrics are presented. The mechanics of nonwoven fabrics, felts made of both natural and synthetic fibers, binders, and the role of nonwoven fabrics that are used in the textile and paper industries are discussed.

Waterstops for joints in concrete. B. Kellam and M. T. Loughborough. J. Am. Concrete Inst. *30*, 1269-86 (June 1959). Waterstops are grouped into six categories, depending on shape and material. Studies indicate that a properly compounded PVC is likely to outlast many of the materials used in the past. An investigation of the watertightness of various shapes and sizes of waterstops is described, from which it is concluded that "flat corrugated" and "flexible metal" types are superior to "dumbbell" and "metal plate" waterstops. Physical properties of waterstops are discussed with reference to their ability to withstand rough treatment during installation and their ability to accommodate joint movements. Waterstops of various shapes and materials are compared with regard to ease of installation. Methods developed for cutting, splicing, and installation of PVC waterstops are outlines.

High density polyethylene protective and functional coatings. S. E. Hmiel and H. G. Grey. SPE J. *15*, 540-42 (July 1959). The typical properties of polyethylene (PE) dispersions of the types primarily used for coating of metals are described. The practical techniques and coating processes used for the polyethylene dispersions are similar to those used for other plastics materials, however, some special techniques are required. Data are presented to indicate the properties which may be obtained on various metal substrates.

Vinyl coverings should meet these tests. C. J. Poiesz. Modern Hospital *92*, 140-48 (Apr. 1959). The properties of vinyl chloride plastic wall coverings are reported and specification requirements for their materials are given. The emphasis is on wall coverings used in hospitals.

Properties

Velocity of sound and internal loss in polymers of methacrylic esters. E. Butta. Ann. chim. (Rome) *48*, 802-10 (1958). The velocity of sound in methyl, ethyl, propyl, and butyl methacrylate polymers decreases with increasing temperature; the rate of decrease increases sharply at a critical temperature which is lower for increasing size of side groups. The internal loss decreases with increasing temperature and with increasing chain length. A plot of the logarithm of internal loss versus the reciprocal of the absolute temperature shows a break at the same critical temperature as was found in the sound experiments. The velocity of sound at room temperature is a linear function of the density of the polymer.

Dielectric loss in 66 nylon (polyhexamethylene adipamide). R. H. Boyd. J. Chem. Phys. *30*, 1276-83 (May 1959). The dielectric loss in 66 nylon was studied over a range of temperatures (—40 to 100° C.) and frequencies (50 cps. to 70 mc.). The effects of radiation induced cross-linking and hydrogen bonding solutes were studied.

Comparison of time dependent mechanical properties of plastics. B. Maxwell. SPE J. *15*, 480-94 (June 1959). Basic principles of creep, stress relaxation, and dynamic properties of plastics are discussed. These time dependent characteristics are rapidly evaluated by use of dynamic tests. Data are given to illustrate the methods of evaluating and comparing materials such as polymethyl methacrylate, polystyrene, polyethylene, and polypropylene. Limits of linear visco-elastic response may be obtained and yield important data and design criteria.

Testing

Contribution to the analytical chemistry of plastics. IX. Analysis of cellulose mixed esters. E. Schroeder, J. Franz, and K. Thinius. Plaste u. Kautschuk 5, 411-15, 423 (1958). A method for determining the acetic and butyric acid contents of cellulose acetate butyrates is described. The method involves saponification, distillation, ion-exchange columns, etc.

Determining epoxy contents of cured and uncured resins. H. C. Anderson. Plastics Tech. *5*, 40-42 (July 1959). The hydrochloric acid method of determining epoxy content of uncured resins is modified so that it is suitable for use with cured epoxy plastics. This method can be used to determine the conversion during cure; the results agree with those determined by infra-red absorption.

Interlaboratory evaluation of testing methods. J. Mandel and T. W. Lashof. ASTM Bull. No. 239, 53-69 (July 1959). The various sources of variability in test methods are examined, and a new general scheme to account for them is proposed. The assumption is made that systematic differences exist between sets of measurements made by the same observer at different times or on different instruments or by different observers in the same or different laboratories and that these systematic differences are linear functions of the magnitude of the measurements. The design, analysis, and interpretation of a round robin in accordance with the linear model are presented, and the procedure is illustrated in terms of the data obtained in an interlaboratory study of the Bekk smoothness tester for paper. It is believed that this approach will overcome the "frustrations" that are often associated with the interpretation of round-robin test data.

Chemistry

Phenol-formaldehyde condensates of defined constitution and uniform molecular size. H. Kämmerer. Angew. Chem. *70*, 390-98 (July 7, 1958). Ordinary phenol-formaldehyde condensates are polymolecular and, depending on the reaction conditions, they are irregular in their structure, every molecule containing different groupings. The preparation of oxymethyl-phenols, which are often the starting compounds **(To page 177)**

U. S. PLASTICS PATENTS

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each.

U. S. Pats., July 7, 1959

Coated abrasive article. R. C. Rinker and H. W. Schnabel (to Armour). 2,893,854.

Polymerizable compositions. A. L. Barney (to Du Pont). 2,893,868.

Thermostable polysulfides. W. F. Taylor (to Minnesota Mining). 2,-893,906.

Photopolymerization. R. Dow (to G. S. Nalle, Jr.). 2,893,937.

Phosphorus - containing polymers. R. J. McManimie (to Monsanto). 2,893,961.

Resin compositions. S. O. Greenlee (to S. C. Johnson). 2,893,965-6-8-74.

Acylricinoleate-fumarate adducts. J. Dazzi (to Monsanto). 2,893,967.

Diisocyanate modified polyester. G. E. Graham and J. A. Parker (to Armstrong Cork). 2,893,969.

Butadiene-styrene copolymer blends. T. J. Kennedy and J. L. Holst (to Phillips). 2,893,971.

Stabilization of polyoxymethylene. M. A. Kubico and R. N. MacDonald (to Du Pont). 2,893,972.

m-Phenylenediamine compositions for curing epoxy ethers. R. Stecklar, F. A. Hessel, and J. Werner (to General Aniline). 2,893,973.

Reduced methacrolein polymers. E. C. Chapin and R. I. Longley, Jr. (to Monsanto). 2,893,979.

Interpolymers of epsilon-caprolactam. G. E. Ham and R. L. Sublett (to Chemstrand). 2,893,980.

Copolymers of dichlorohexafluorobutene. E. S. Lo (to Minneosta Mining). 2,893,983.

Polymerization of alpha-olefins. C. W. Seelbach and W. J. G. McCulloch (to Esso). 2,893,984.

Polymerization of olefins. R. V. N. Powelson (to Sun). 2,893,985.

U. S. Pats., July 14, 1959

Breathable vinyl-coated fabric. R. J. Wilhelm and C. A. Waugaman (to B. F. Goodrich). 2,894,855.

Polymers of hydrocyanic acid. J. C. Burleson (to Monsanto). 2,894,916.

Cation-exchange resins. Y. Tsunoda, M. Seko, M. Watanabi, and T. Misumi (to Asahi Kasei). 2,894,917.

Stabilized hydrophilic polymers. J. F. Jones (to Goodrich). 2,894,921.

Halogen-containing resins. P. R. Graham (to Monsanto). 2,894,923.

Polyhydroxy ethers of phenolic resins. G. R. Somerville and H. W. Howard (to Shell). 2,894,931.

Vinyl aromatic polymers stabilized with polyureides. W. K. Schweitzer, Jr. (to Dow). 2,894,933.

Polyurethane production. W. F. Tousignant and H. Pledger, Jr. (to Dow). 2,894,935.

Reaction products of trimethylenecyclohexane. R. E. Benson (to Du Pont). 2,894,936.

Preparation of petroleum resins. F. W. Banes, J. F. Nelson, and R. F. Leary (to Esso). 2,894,938.

Polymerized fatty acid mixtures. B. L. Hampton (to Glidden). 2,894,-939.

Resins from acid-charred lignins. R. L. Sperry. 2,894,940.

Ion-exchange resin battery. M. Schwarz and P. J. Franklin (to U. S.). 2,895,000

U. S. Pats., July 21, 1959

Oxetane polymers. C. C. Price (to Hercules). 2,895,921 and 2,895,924.

Aminotriazine modified polyacetals. B. H. Kress (to Quaker Chemical). 2,895,923.

Anion-exchange resin. J. C. H. Hwa (to Rohm & Haas). 2,895,925.

Polyurethane foam. G. Rappaport, J. A. Szaruga, and J. R. Wall (to General Motors). 2,895,926.

Blood-phenolic resin composition. C. N. Cone (to American Marietta). 2,895,928.

Polymerizable epoxide-alkyd resin. M. Yusem (to Bradley & Vrooman). 2,895,929-30.

Oxetane polymers. E. D. Klug (to Hercules). 2,895,931.

Isophthalic and orthophthalic resins. M. J. Schlatter and F. G. Lum (to California Research). 2,895,932.

Resins from coal acids. W. L. Archer and R. S. Montgomery (to Dow). 2,895,934-5-6.

Styrene-acrylonitrile copolymers. H. Ohlinger and R. Fricker (to Badische Anilin). 2,895,938.

Stabilized vinyl chloride resins. C. W. Montgomery and R. C. Bryan, Jr. (to Ethyl). 2,895,941.

Polymeric methyl isopropenyl ketone. L. J. Rosen (to Celanese). 2,895,942-3.

Di-oxo-alkane polymers. H. F. Mark (to R. S. Aries). 2,895,944.

Polyerythritol - aldehyde polymers. R. F. Fischer and T. F. Mika (to Shell). 2,895,945.

Modified polyesters. W. A. H. Huffman (to Chemstrand). 2,895,946.

Polymerization of di-2,3-epoxypropyl phthalate. E. C. Shokal and A. C. Mueller (to Shell Development). 2,895,947.

Polybenzimidazoles. K. C. Brinker and I. M. Robinson (to Du Pont). 2,895,948.

Acrylonitrile copolymers. W. M. Thomas (to American Cyanamid). 2,895,949.

Compositions of a hydroperoxide and acrylate acid diester. V. K. Krieble (to American Sealants). 2,895,-950.

U. S. Pats., July 28, 1959

Shaped articles of crystalline polystyrene. G. Natta and G. Crespi (to Montecatini). 2,896,264.

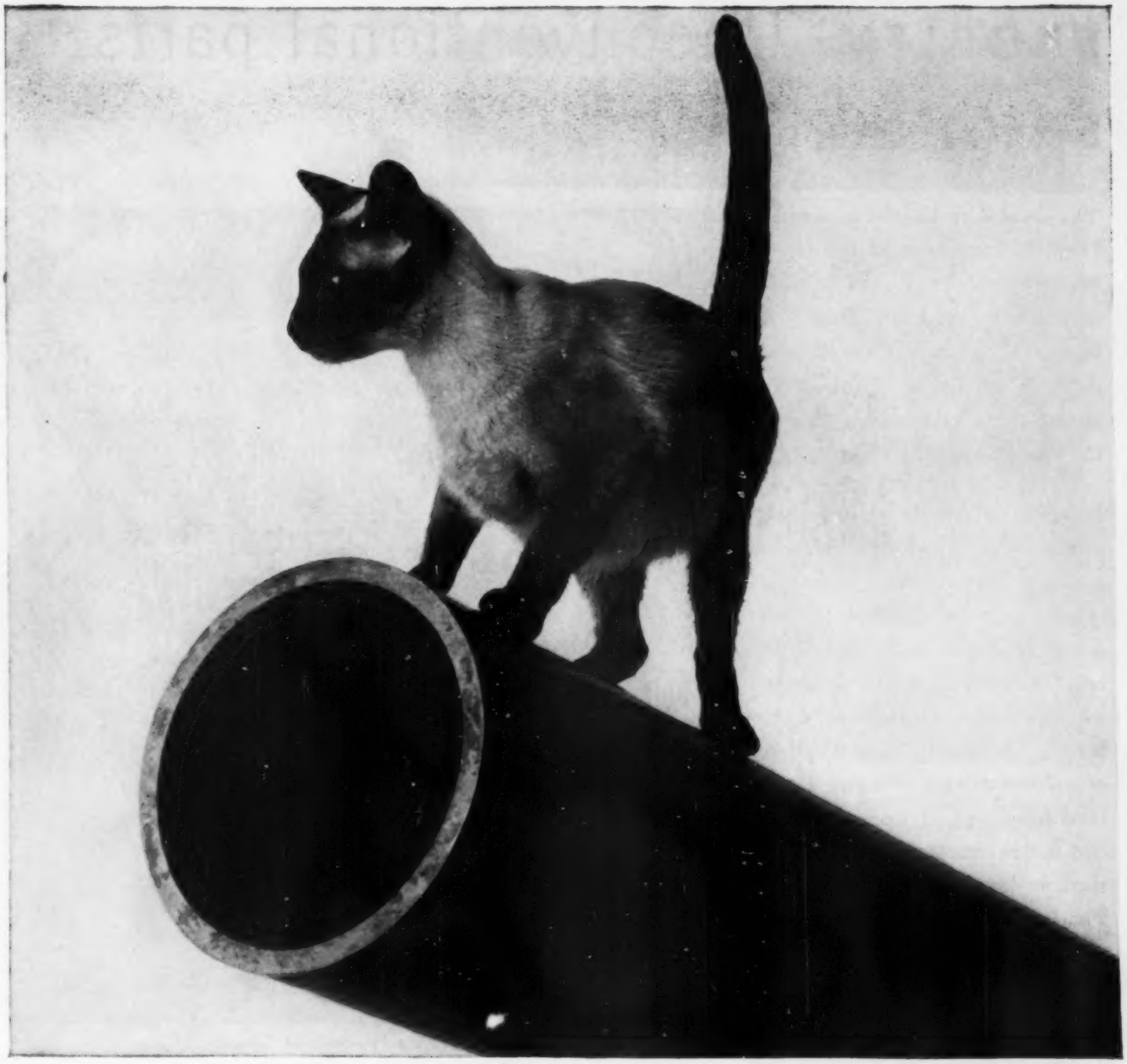
Cross-linked polyvinyl alcohol. A. A. Miller (to General Electric). 2,897,-127.

Polymers from polyoxyalkylene polyols and butadiene epoxide. J. W. Clark and A. E. Winslow (to Union Carbide). 2,897,163.

Copolymers of conjugated diolefins and methyl isopropenyl ketone. R. R. Dreisbach and G. B. Sterling (to Dow). 2,897,167.

Plasticized polyvinyl halides. J. Dazzi (to Monsanto). 2,897,169.

Phenolic molding resins. L. Czerny and J. Schmitz (to Chemische Werke Albert). 2,897,171.—End



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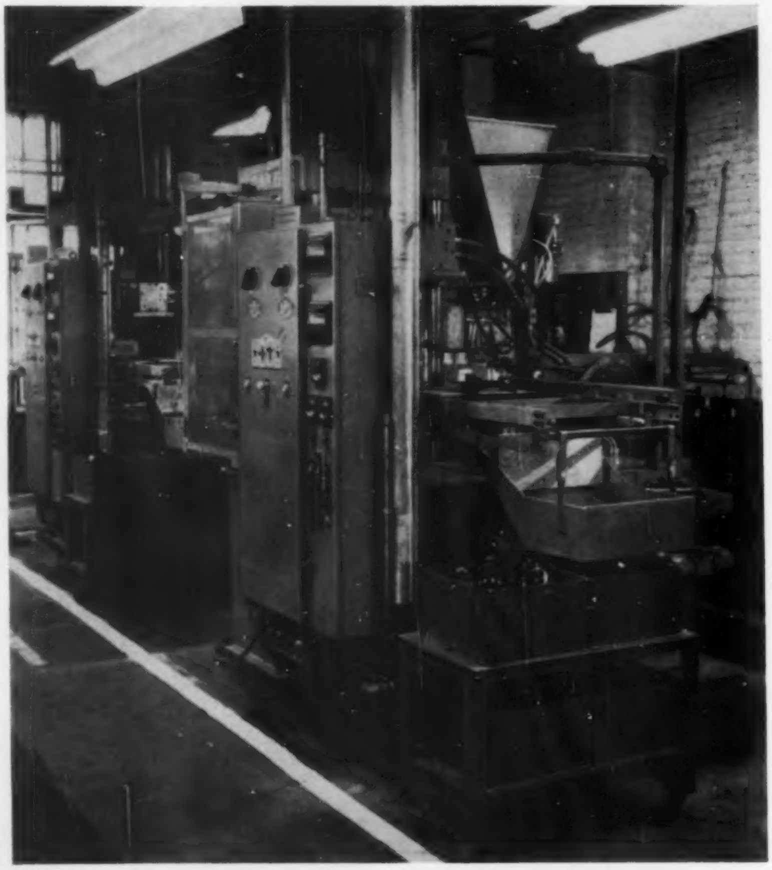

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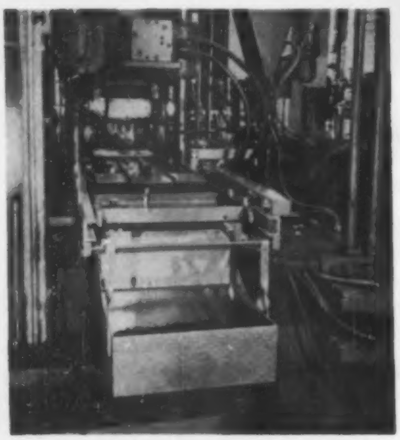

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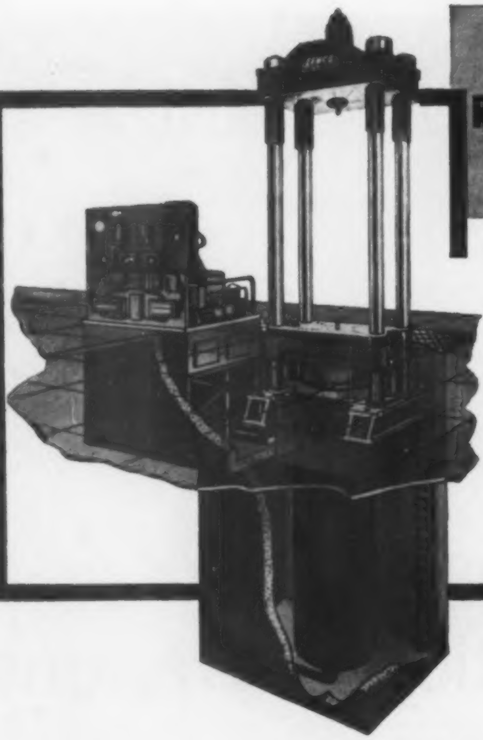

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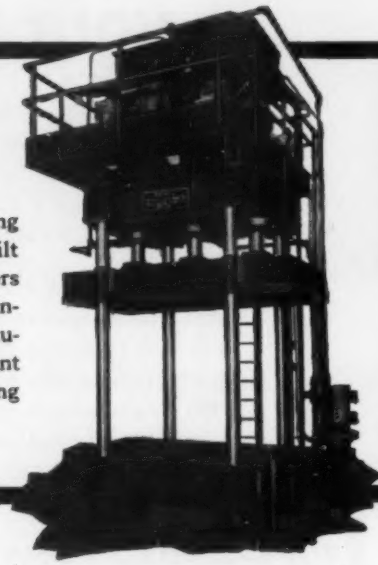

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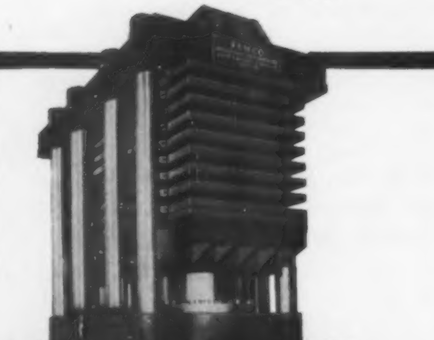

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Now . . . a completely new standard of color permanence for reds! MONASTRAL RED B RT-742-D, MONASTRAL RED Y RT-759-D and MONASTRAL VIOLET R RT-733-D offer lightfastness, brilliance and heat resistance for lasting colors in plastic products for outdoor use; resistance to plasticizer bleed and to chemicals for plastisols and upholstery materials; outstanding resistance to crocking, bronzing and migration for plastics in general. For full information, contact your Du Pont Pigments representative or write: E. I. du Pont de Nemours & Co. (Inc.), Pigments Department, Wilmington 98, Delaware.
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY
DU PONT
REG. U. S. PAT. OFF.
The ink used in this advertisement was made with MONASTRAL RED pigment.

extrusion pays off 3 WAYS

1 BETTER PRODUCT

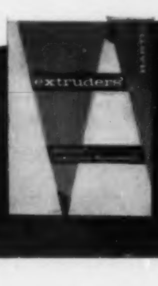
Precision extrusion gives uniformity and reproducibility, particularly important in extrusion of sheet for sheet-forming and tubing for blow molding. Eliminates rejects due to thin spots, thick sections, or porosity.

2 LOWER MATERIAL COSTS

Closer control of tolerances, including crosswise tolerances, reduces the necessity for allowing excess material in order to meet minimum thickness requirements.

3 HIGHER OUTPUT

All Hartig research and development has been directed toward greater production efficiency. Hartig extruders are known for their higher production rate; ease of set-up, start-up and purging, as well as for their dependable automatic operation with a minimum of downtime for maintenance.



Send for your copy of the new illustrated booklet describing the line of Hartig Extruders and Matched Auxiliary Equipment.

HARTIG EXTRUDERS

Division of Midland-Ross Corporation

MOUNTAINSIDE, NEW JERSEY

Only in Plastics could they make

The Incredible Visible Man

Only by the SHAW PROCESS could the molds be made with Faithful Reproduction, Speed and Low Cost

Overall height 15 inches

Designed and Merchandised by Renwal Blueprint Models Mineola, New York

Imagine the exactness of detail required to have 67 pieces of varying shapes and sizes fit together easily and perfectly.

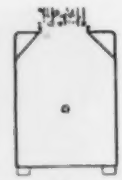
Molds for these 67 pieces were *reproduced by the Shaw Process from the original Plaster models*—carefully engineered into 3 basic molds having Beryllium Copper Cavities.

Just think of the hours of machining time saved—this meant a big saving in both time and money in getting this complicated project started.

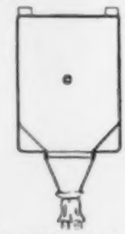
A combination of Standard's engineering know-how and experience in production gained in 48 years might easily be valuable to you.

STANDARD TOOL CO. 213 Hamilton Street, Leominster, Massachusetts

OMNI PRODUCTS CORP., Export Distributor, New York, N. Y.

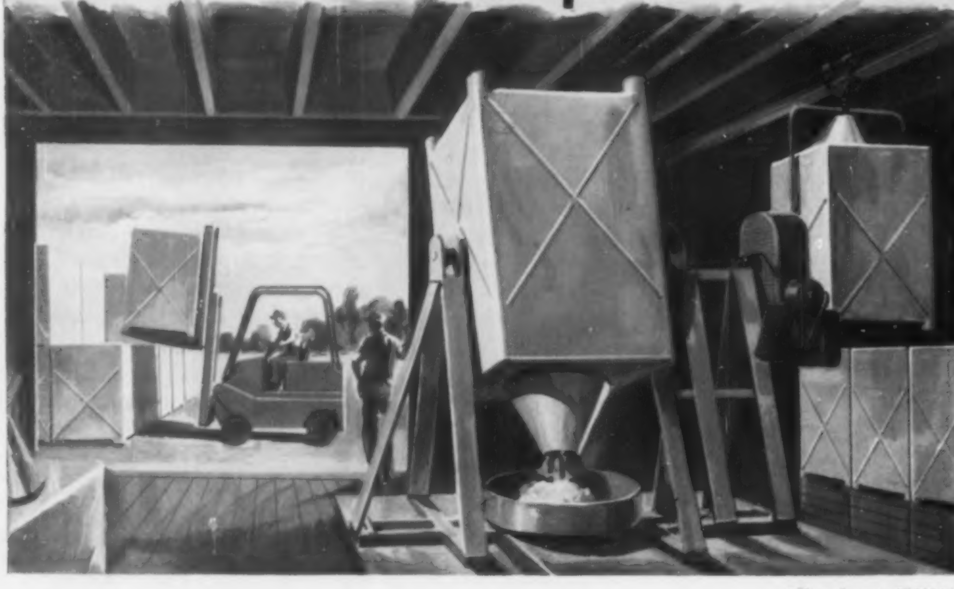


Fills Fast—22" opening permits fast filling of powdered materials. Internal cone conforms to angle of repose of product.



Empties Clean—Internal cone funnels all materials out of bin. No residue remaining.

Waste of labor and product is obsolete...



Stores Outdoors—Weatherproof, turns yard area into warehouse. Stacks 2 high.

Cuts Shipping Costs—low cost flat-bed equipment considered part of special rail car with "freight free" advantages.

* Lic. under pat. #2862645

Waste of labor, product, floor space, time is now outmoded—eliminate it in your plant today.

Powell's new Invert-a-bin* Semi-Bulk Handling System has put an end to the biggest headache in handling granular products. These sturdy, easy-to-handle steel or aluminum containers are easy to fill and easy to empty. Weatherproof, they can be stored outdoors freeing indoor storage areas for production.

Ideal for inter-plant or intra-plant these units are considered part of special rail car with "freight free" advantages. Due to the simplicity of design, maintenance of the Invert-a-bin* is nil.

Why continue losing time and money with old style disposable packages when this remarkable new Invert-a-bin* is immediately available on either lease or purchase. Write for literature today!

POWELL PRESSED STEEL Since 1920 HUBBARD, OHIO

THE POWELL PRESSED STEEL COMPANY

HUBBARD, OHIO

Two of many current applications of U.S. Royalite

CAMPCO PROGRESS / *latest developments in plastic sheet · film · fabrication*

Campco Styrene

Goes Dimensional in big way!

Giant self-service, freezer displays selling King Sun frozen fresh citrus juices, are booming sales of the packaged sunshine in scores of super markets. Because the versatile units are so light, attractive, and easy to move—stores can put them to work in different freezer locations . . . move them to meet changing merchandising opportunities.

Dimensional Products Inc. of Milwaukee, a leading producer of p-o-p

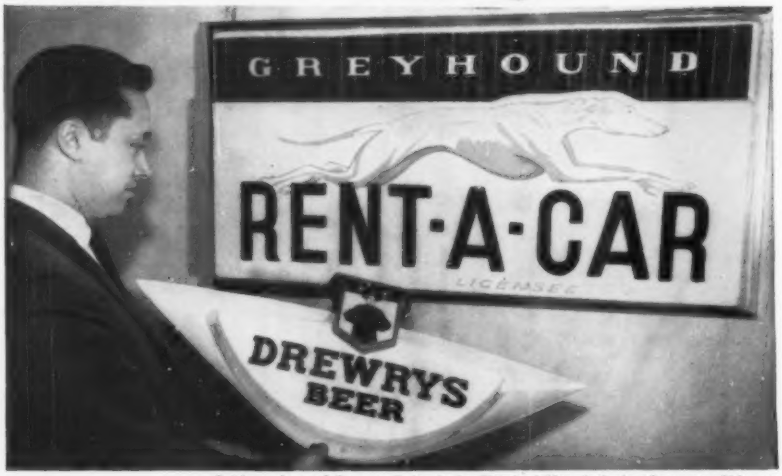
materials, vacuum formed the handsome freezer cabinet in two pieces from Campco S-540, Rubber Modified Styrene Sheet; selected this particular Campco plastic for its excellent thermal and forming properties. The bottom section alone, with base dimensions of 48"x60", required a complex deep draw of 30"—accomplished easily using .187" thick Campco sheet. Best of all, the material's dimensional stability in forming and high-impact strength after, assured a cabinet that would withstand tough super market usage.

Particularly valuable to Dimensional Products Inc. were the fine surface characteristics of Campco S-540. Using a PM finish sheet which has a polished smooth surface on one side—mat on the other, they were assured exact uniformity from sheet to sheet . . . repeatability of product after forming.

Campco S-540 is completely adaptable for printing by any of the commonly recognized processes—letterpress, offset and silk screening. Special inks are of course required to insure effective bond. Decal transfers are easily applied. The combination of printing with forming make the sheet ideal for advertising signs, colorful containers, and unique 3-dimensional displays. The approved method is to print flat on the Campco sheet, then form and trim to shape.

Available in full range of colors, translucent and opaque from .01" to .187" thick, stock and custom sheets.

Campco Butyrate scores in weather tests, opens new vistas in outdoor signs



Outdoor signs of Campco Butyrate by Standard Manufacturing Company, Chicago

Colorful outdoor plastic signs that can withstand weather hazards without becoming brittle or losing their brilliance are now possible with a special Campco Butyrate sheet. Made from resin supplied by Eastman Chemical Products, Inc., Campco Butyrate is tough, durable, easy to form, and completely weather resistant.

Weather-test results at Arizona checking stations assure the resistance of Campco Butyrate to extremes of sunlight, rain, heat, cold, snow and wind. Moreover, its surface resists dirt build-up and washes clean in rain.

Because Campco Butyrate is strong and resilient even in thin sections, substantial savings can be effected in its application for outdoor signs. A little goes a long way. Its ease of forming opens unlimited design opportunity—imaginative shapes . . . new vistas in outdoor signs.

Campco Butyrate is available in clear crystal or a variety of colors—rolls and sheets in thicknesses .005" to .125" stock or custom size. Clarity ranges from transparent through translucent to opaque.

It's easy to decorate by either lacquer or silk-screening. Attractive combinations of bright trademarks, slogans or other wording against colored or clear background are easy to achieve.

Campco Woodgrain Sheet sells "A'lure"

Handsome counter displays of Campco Woodgrain finish plastic sheet are helping to sell Warner Brothers "A'lure" bras in apparel stores throughout the country. This new Campco sheet looks like solid wood but is light as a feather, and has all the excellent qualities of standard Campco sheet . . . high impact resistance, dimensional stability and outstanding formability. Available in cut-to-size and standard sheets from 040" to .187" thick.

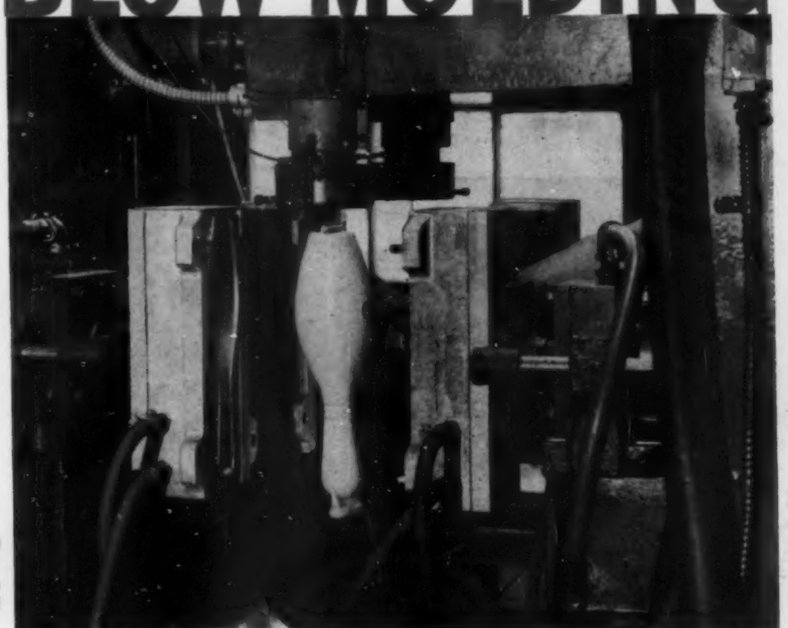
Received Your Campco Personal File? This data-packed reference file on thermo-plastic sheet and film is yours on request—just send name and address on Company letterhead to Campco, 2721 Normandy Avenue, Chicago 35, Illinois.

CAMPCO Sheet and Film, **a Division of Chicago Molded Products Corp.**

November 1959, Volume 37, Number 3

MODERN PLASTICS

COMPRESSION INJECTION EXTRUSION THERMOFORMING ...and now BLOW MOLDING



CLOSE-UP of toy polyethylene bowling pin that is being removed from blow molding machine. Pin was blown from heated hollow tube (parison) extruded downward into molds.

Photo, Star Plastic Specialties

The almost explosive force with which the blow molding technique has taken its long over-due plunge into "big business" can best be summarized by listing the following set of startling growth statistics:

From the early '40's until 1957, the total number of companies in this country doing blow molding was never more than seven. As of this writing, at the close of 1959, the unofficial count has been pegged at 80. At least 100 more will probably be in business by the end of 1960, and expectations are for a total figure of 1000—including both custom and proprietary molders—by 1965!

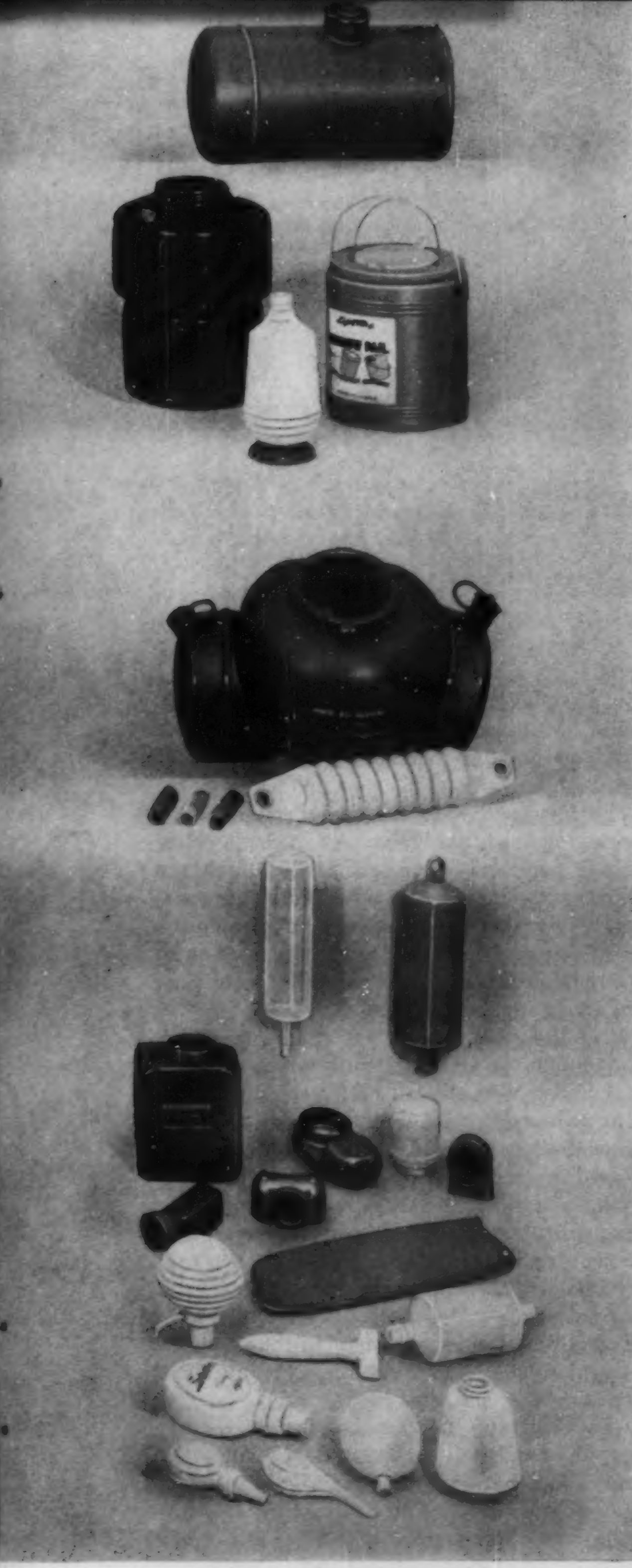
This article, the first in a series, will analyze some of the exciting new markets that have just begun to open up for blow molded products in toys, housewares, automotive parts,

TOYS

1. Car body (High-Density PE)
2. Fire hydrant bank (PE Blend)
3. Animal bank (Low-Density PE)
4. Barbell set (PE Blend)
5. Doll body, legs (PE Blend)
6. Large doll body (PE Blend)
7. "Squeeze" rocket launcher (L-D PE)
8. Poppit beads (L-D PE)
9. Play brick (Medium-Density PE)
10. Indian pin (PE Blend)
11. Milk can (H-D PE)
12. Handled jug, cap (H-D PE)
13. Model train (L-D PE)
14. Hand grenade (H-D PE)
15. Sling shot (PE Blend)
16. Alligator (L-D PE)
17. Croquet mallet (H-D PE)
18. Cane head (H-D PE)
19. Pumpkin (L-D PE)
20. "Squeeze" cannon (L-D PE)
21. Horseshoe (L-D PE)
22. Checker (L-D PE)
23. Cartoon character dispensers for children's vitamins (M-D PE)
24. Car wheel (H-D PE)

CONTAINERS—INDUSTRIAL AND CONSUMER

25. Twenty-gal. carboy (H-D PE)
26. Milk container (H-D PE)
27. 1½-gal. gasoline can (H-D PE)
28. Five-gal. gasoline container (H-D PE)
29. Standard mason jar for chemicals (H-D PE)
30. Urinal (Acetate)
31. Gasoline tank for small engine (H-D PE)
32. Shampoo bottle (H-D PE)
33. Hot water bottle for children (L-D PE)
34., 35., 36., 37. Standard bottles and parts (H-D PE)
38. Family group of bottles (L-D PE)
39. Container for lighter fluid (Acetate)
40. Cosmetics container (H-D PE)
41. Stock bottle (Acetate)



and industrial components. Subsequent articles will deal with packaging, techniques, equipment, and future potential.

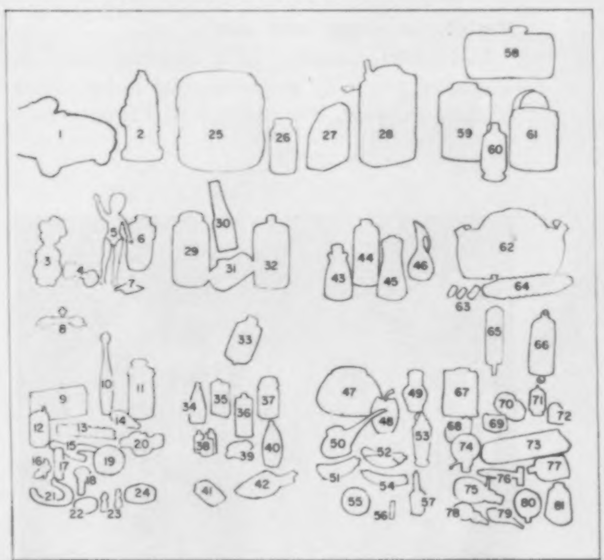
Materials and methods

Two reasons are generally advanced for the sudden growth and interest in blow molding. One is the recent availability of high-density polyethylene, which has given the blow molder the rigidity and toughness he required for many applications, plus the cost-cutting advantage of being able to reduce wall thicknesses without affecting performance. More than half of the new applications shown at left are molded of high density or of blends involving high- and low-density materials. One oft-quoted prediction anticipates the development of a market of from anywhere between 200 to 250 million lb. of high-density polyethylene by 1965 for blow molded packages, toys, housewares, and industrial components.

The other reason advanced to explain blow molding's growth was the introduction, within the past two years, of a large array of commer-

EIGHTY-ONE blow molded products — all commercial either here or in Europe—indicate the wide range of possibilities. Each of the products is identified below.

Photo, Celanese Plastics Co.



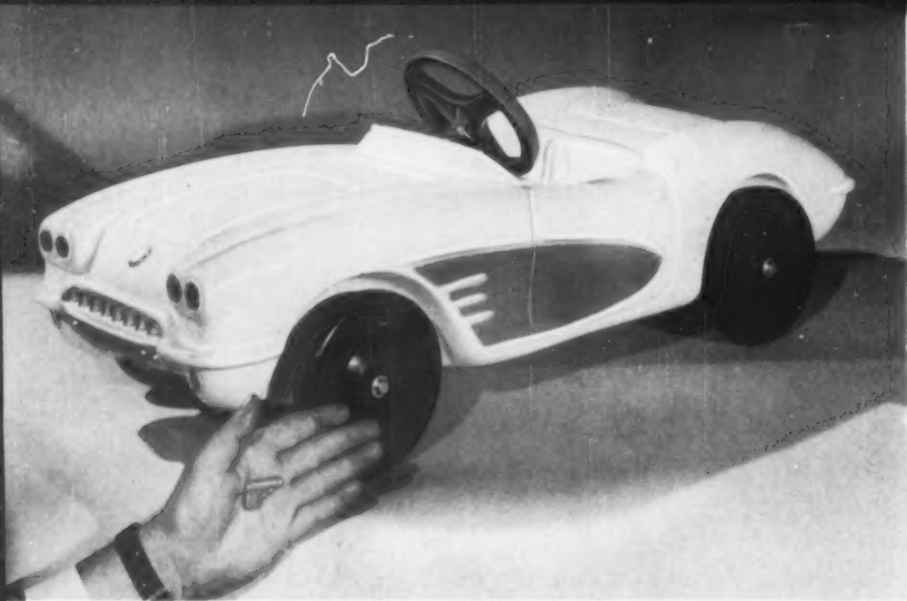
42. "Fish" bottle for bubble bath solution (L-D PE)

HOUSEWARES

43. Carafe (H-D PE)
44. Double-wall thermos (H-D PE)
45. Juice decanter (PE Blend)
46. Bud vase (H-D PE)
47. Vaporizer which holds 1 gal. of water (H-D PE)
48. Jam container (H-D PE)
49. Coffee bottle (H-D PE)
50. Watering can (L-D PE)
51., 52., 53., 54. Condiment dispensers (L-D PE)
55. Simulated milk glass base for hurricane lamp (Styrene)
56. Stock container (Acetate)
57. Salad dressing bottle (Rigid Vinyl)

INDUSTRIAL

58. Insecticide tank (H-D PE)
59. Lab jar for inserting parts into steam table (H-D PE)
60. Seltzer bottle (H-D PE)
61. Minnow pail (L-D PE)
62. Insecticide tank (H-D PE)
63. Grip handles (H-D PE)
64. Boat bumper (H-D PE)
65. Saline solution jar (H-D PE)
66. Boat bumper (H-D PE)
67. Reservoir for windshield wiper fluid (H-D PE)
68., 69., 70. Air intake silencer parts for carburetor (H-D PE)
71. Brake fluid reservoir (H-D PE)
72. Carburetor part (H-D PE)
73. Sun visor (PE Blend)
74. "Bellows-type" whiskey dispenser (L-D PE)
75. Whiskey dispenser (L-D PE)
76. Paint brush handle (H-D PE)
77. Container for saline solution (H-D PE)
78. Stock dispenser cap (L-D PE)
79. Oil pump (H-D PE)
80. Toilet float (H-D PE)
81. Globe unit for soap dispenser (H-D PE)



WIDE size range possible with blow molding is illustrated by toy gun, approximately ¾ in. long, and toy car body, over 3 ft. long and weighing about 3 pounds. Both of the toys are molded of polyethylene.

cial stock machines. Some 28 American and foreign manufacturers had, by the end of 1959, announced the availability of blow molding units. It is estimated that between 350 and 400 machines are in use in this country today; and, while it is true that at least 75% of these are owned by the half-dozen large blow molders tied in with large-volume packaging applications, the fact that two years ago these six owned *all* the machines still gives some indication of how fast the field is growing.

Variety in shape and size

Until fairly recently blow molding and bottles have generally been regarded as two faces of the same coin. For years, it had been generally accepted by the industry that a Boston round bottle was the ideal shape to come out of a blow molding machine.

But no longer!

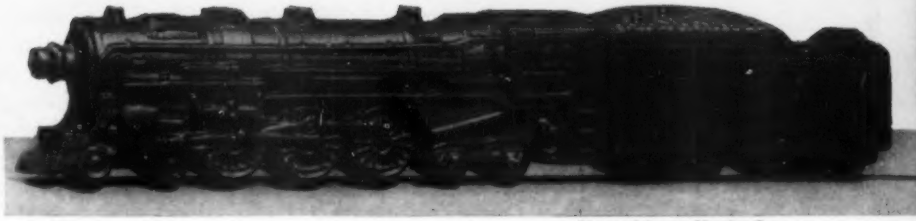
The imaginative styling and complex engineering going into many of today's blow molded products—as dramatically illustrated on pp. 84-85—have belied any doubts industrial designers might have had on the technique's versatility, and have certainly helped to push blow molding into so many of the new non-packaging applications.

With the exception of one machine which blow molds products from doubled-up roll-stock sheet, virtually all blow molding equipment is based on the same basic principle: a heated hollow tube of plastic (a parison) is trapped in a mold and by means of air pressure is inflated against the mold, with the pressure being maintained until the material sets up in the required shape. Basically, this means that blow molding is ideal for hollow products, fully enclosed or open at some point—in which case the opening must be smaller than the diameter of the main body. However, the technique permits numerous and versatile variations:

—By designing the mold so that in certain areas the walls of the parison are made to squeeze together and fuse into a solid piece, it is possible to design products with a cross-section incorporating both hollow and solid

REALISTIC DOLL BODIES—these two stand about 1½ ft. high—blow molded of polyethylene shape up as major new market for the technique. Cost-wise, the application has already proved itself out in the toy industry.

RELATIVELY intricate detail, such as is shown in this close-up of toy engine, presents no problems for the blow molding technique.



Photo, Celanese Plastics Co.

areas, such as the toy wheel shown below, in which the *hollow wheel and the solid rim are blow molded in one piece.*

—Several molders are now working on the concept of blowing products with inserts in them. Two such products are already on the market—the insecticide spray tank (62)[1] has a circular metal insert in its rim and the toilet float (80) has a small threaded brass insert in one end—and more are on the way. One technique currently in use is to place the insert around the blowing mandrel and allow the mold to compress the material around the insert. Flanges in the insert enable the plastic to lock it securely in place.

—Precision blow molding has facilitated the production of products with intricate detail (see photo, above), or those in which relatively close tolerances are involved. One revolutionary concept is that of blow molding the top and bottom of a two-piece unit in one shot and then slicing the two apart so that they fit together. The threaded cap and container shown on p. 88 is one such example. Reportedly, cans and pails with snap-fit lids will soon be made in the same way.

—Blowing a hollow object with folds that function like a bellows has already opened a number of unique applications, such as the dispenser unit shown in the bottom of the picture on p. 85 (74). One molder is even suggesting blow molded housings in which the "bellows" would function as movable joints.

And size is no problem—whether the piece is 1 in. long or 3 ft. long. You can soon expect equipment that can turn parts out 8 ft. long and 4 ft. deep.

Parts with varying wall thicknesses are relatively easy to blow and much work is now being done with blowing parts with wall sections in the 10-mil range. In Germany, a thin-wall glove is already being blown of vinyl. In this country, thin-wall blown polyethylene containers are being used as linings for cardboard cartons; and thin-wall toothpaste-type tubes are to be released soon.

Multi-cavity molds are also the subject of considerable research and will be discussed more fully in a subsequent article. At this point, however, it may be well to note that many imaginative concepts have been developed in this area, including blowing two pieces as a single unit (e.g., visualize two inverted, tapering flower pots joined together at the perimeters of their larger diameter ends) and then slicing them apart.

The materials picture

To match the versatility offered by the blow molding operation, materials suppliers are now concentrating on their end of the picture;

CROSS-SECTION of high-density polyethylene toy wheel demonstrates versatility of blow molding technique in turning out product that effectively combines hollow and solid sections. Wheels of this type—which incorporate rim and bearing in a single part—are already being considered for lawn mowers, golf carts, etc.

[1]Numbers in parentheses refer to the photo on pp. 84-85.

again, at this writing, it appears as if PE will take the lion's share of the market. For some of the smaller items where a certain degree of flexibility may be required, the low-density materials will probably be used; as the products become larger, however, high-density polyethylene will come into play. As just one example, one manufacturer reports that by switching from conventional to high-density PE on a blow molded bat he was able to reduce the weight from 235 g. to 140 g.—a 45% savings in material's cost and a more rigid, stiffer product to boot.

Of interest in this area, too, is the growing importance of blends and copolymers of polyethylene. Bowling pins, for example, which cannot be too light in weight, are being produced by some manufacturers using a 50/50 blend of low- and high-density PE. An 11-in. pin made of this blend weighs 66 g., compared to 88 g. for low density. Special polyethylene blends have also been developed for the doll field to give the dull finish and elastic recovery desired.

But while the applications shown in the photo on pp. 84-85 are almost all polyethylene, there are several blow molded of other materials. The urinal (30), the lighter fluid container (39), and two of the stock bottles (41 and 56) are blow molded of acetate; the salad dressing bottle (57) is blow molded of rigid PVC; and the simulated milk glass component for a hurricane lamp (55) is blow molded of styrene. None of these can be overlooked—nor can any of the other thermoplastics which can easily be blow molded.

The cellulosics, for example, are already being used in Europe for lighter fluid containers and several companies in this country are investigating its possibilities. Cellulose propionate looks as if it also will be playing a major role in blow molding's development.

Styrene, because of its low cost and the ease with which it can be decorated, may also be an important contender. In Germany, it is already being used for containers, and another overseas manufacturer is reportedly readying a double-wall coffee cup blow molded of styrene (the two halves are blow molded separately and later joined together). Simulated Venetian glassware blow molded of styrene is also in overseas markets.

Several rigid PVC containers are already in use. One manufacturer in this country is starting to blow vinyl components for model airplanes (wings and bodies), and in Germany, they are currently marketing a hand tool grip of vinyl. The grip is slipped over the tool as a hot sleeve; when it cools, it shrinks tightly over the handle.

Photo, Boston Plastic Machinery, Inc.

PRECISION BLOW MOLDING introduces new concept of producing cap and bottle as one unit. As it comes from the blow molding machine (left), cap, internal threads, external threads, and bottle are all one piece. Cap and internal threads are then cut off from rest of bottle and screwed into place (center) to make the finished product (right). The threads mate perfectly to insure a tight fit.

Economy is the big plus

Falling as it does between injection molding and thermoforming, blow molding offers obvious economies for any hollow object: If thermoformed, the two formed pieces would have to be joined; if injection molded, secondary assembly operations or costly matching cores would be required.

Take a utility pitcher for example. To produce such a part (including the handle) by injection molding, it was necessary either to mold two halves and cement them together or else use inflatable cores. The blow molding process provided the perfect solution by turning out pitchers with solid or hollow handles plus an ice deflector on the rim—all in one piece! Trimming, of course, is necessary but this is a task usually performed by the machine operator.

In other areas, the blow molding technique provides further economies. Mold costs, cavity for cavity, are estimated to run from ¼ to ⅓ that for injection molding. A typical mold for blowing a 1-gal. jug would probably run no more than $1000. Cycles can be relatively fast —on some smaller pieces re- (To page 179)

Longest RP pipe in Europe

Swedish manufacturer develops new techniques to produce reinforced plastic pipe in 33-ft. section, 3¼-ft. diameter, 0.20-in. walls

Sewer mains of reinforced plastic pipe have now become a distinct possibility. The successful application of this material by the Swedish Forest Owners' Association in a one-mile line carrying acid-containing waste water from a new cellulose plant may have opened the field of sewer mains to RP pipe.

The installation, reportedly the largest in Europe, consists of 33-ft. sections joined on the site by resin-impregnated glass cloth. The sections are made by Höganäs-Billesholm Co., Stockholm, Sweden, by a modified mandrel-wrap technique. Rate of production was 132 ft. per day. The equipment consists of a mandrel with adjustable diameter. The company has three machines capable of producing diameters from about 3½ in. to almost 6 feet.

The mandrel, suspended from a railing near the plant ceiling, travels past a woven roving dispensing roll and a polyester impregnating and curing unit at a predetermined speed. The glass cloth is applied as the mandrel rotates. Cure takes place in a drum type oven under which the mandrel moves.—End

Photo, The American Swedish News Exchange Inc.

ONE-MILE pipe line being installed to carry acid containing waste; 33-ft. sections are joined on site with resin impregnated fibrous glass.

←
WOVEN ROVING is laid up on mandrel from continuous roll. Drum-like white unit in center is impregnating and curing device under which laid up pipe moves.

→
CLOSE-UP of end plate, showing arrangement for diameter variations. This machine produces diameters from 600 to 1500 mm. (2 to 5½ ft. approximately) at a rate of about 75 ft. per 8-hr. shift.

Research, born of necessity, is bringing progress in self-extinguishing plastics

Following publication of our September lead article "What about flame resistance in plastics?" the editors have received much correspondence, particularly from end-users and processors who want to know what self-extinguishing plastics materials are available.

Beyond that interest, these correspondents want to see some "score of effectiveness" related to these materials, to give them an opportunity to compare.

Opposite this page is MODERN PLASTICS' answer to these inquiries: The first chart ever published presenting what is presently available in self-extinguishing plastics.

The chart is broken down into three sections: Resins and Molding Compounds; Film, Sheeting, and Laminates; and Plastic Foams.

The chart is as complete as it is possible to make it at this time, but day-to-day developments in a period of accelerated research may well render it incomplete and at least partially obsolete in the months to come. Therefore, MODERN PLASTICS, in reading-matter columns, will list further developments as they occur.

What tests mean

In using this chart, particularly as concerns tests passed by materials, certain fringe understanding may be necessary.

Possibly the best definition of self-extinguishing is "a property of material denoting that it will not burn once an outside source of flame is removed. Self-extinguishing materials may be combustible as long as an outside source of flame or heat is present."

ASTM D-635 and ASTM D-568 are tentative tests. D-635 is for determining rate of burning of plastics specimens 0.050 in. and thicker; D-568 is for specimens under 0.050 in. thick.

ASTM D-876 is a tentative method for testing non-rigid polyvinyl chloride tubing.

In the Film, Sheeting and Laminates Chart and also in the Foams Chart, there are several references to ASTM D-1692. Again, this is a tentative test to be used to gage flammability of plastics sheeting and foams.

Several references are made to the Underwriters Laboratories test and that of the National Electrical Manufacturers Association. In the UL test, a ⅛-in. thick specimen is held horizontally in a gas flame for 10 sec., and results are expressed as time to extinguishing once the flame has been removed. The NEMA test was developed by that organization's switchgear committee, using modified Bureau of Mines apparatus. The results are expressed in ignition and extinguishing time in seconds on specimens ½ by ½ by 5 in. in size.

References to CS-192-53 on the chart indicates use of an S.P.I. 45° flammability test for film 0.004-in. thick and thicker.

References to the S.P.I. test on the Foams Chart denote a flammability test proposed by the Cellular Plastics Division of S.P.I.

In addition to the basic military test, designated MIL-M-14F, there is a related test known as MIL-M-14E.

It will be seen that only the UL test, the S.P.I. film flammability test, and the military specification test are firmly entrenched as modus operandi. The other tests referred to in the chart and pointed up here are all tentative, although the ASTM tests are now quite generally used in evaluating the self-extinguishing properties of plastics.

As pointed out in our September article, the conversion of a normally flammable material into a self-extinguishing material can and may cause a decline in other important property values. Beyond these changes in property values can come other changes quite likely to affect the economics of a given application. Such things as melt index, flow properties, cooling cycle, gating required, even mold design, may be so affected. Processors of self-extinguishing plastics will do well to check throughout their material markets on all of the above points.—End

Additional copies of the chart may be obtained —at 30¢ per chart—by writing to Readers' Service Dept., Modern Plastics Magazine, 575 Madison Ave., New York 22, N. Y.

This chart represents pages 91 to 98 of the November issue of Modern Plastics.

Additional copies of this chart may be obtained at 30¢ per copy in quantities up to 99. Quotations for quantity orders (100 copies and up) available on request. Write Modern Plastics Magazine, Readers' Service Dept., 575 Madison Ave., New York 22, N.Y.

MODERN PLASTICS

RESINS AND MOLDING COMP

MANUFACTURER	TRADE NAME AND NUMBER	TYPE OF RESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F, PSI	IMPACT NOTCHED IZOD AT 72°F FT-LB/IN OF NOTCH	HARDNESS (1)	SPEC GRAV
ALCYLITE PLASTICS AND CHEMICAL CORP.	Alcylite 201 FP	Phenolic	MIL-M-14F	6,000	2.0		1.3
ALLIED CHEMICAL CORP. Plastics & Coal Chemicals Division	Plaskon UFR-28	Urea	ASTM D635 UL Test (2)	5,000-10,000	0.25-0.35	116-120(M)	1.47-
"	Plaskon Melamine	Melamine	"	5,000-10,000	"	118-124(M)	"
"	Plaskon 8200	Nylon	ASTM D635	12,000	1.2	118(R)	1.1
"	Plaskon 417, 422, 446	Alkyd	"	3,000-9,000	0.25-12	60-80(B)	2.02-
AMERICAN CYANAMID CO. Plastics & Resins Div.	Laminac 4146A	Polyester	ASTM D635	9,100	0.2	40-45(B)	1.4
"	Cymel 3135, 3136	Melamine (3135 Glass Fiber Filled)	ASTM D635 MIL-M-14F	5,000-5,900	0.5-6.0		1.94-
"	Cymel 592, 3020 1502, 1500	Melamine 592-Mineral Filled 3020-Rag Filled 1502-Cellulose Filled 1500-Wood Flour Filled	"	5,500-10,000	0.26-0.9	90-100(E)	1.43-
"	Cymel 1077 & Cymel 1079	Melamine Alpha Cellulose Filled	"	7,000-8,000	0.24-0.28	110 (E)	1.
"	Beetle	Urea Alpha Cellulose Filled	ASTM D635	5,500-7,000	"	94-97(E)	"
ATLAS POWDER CO.	Thermaflow 400	Polyester	ASTM D635 ASTM D568 MIL-M-14F	6,000-10,000	10-16	70-75(B)	1.
"	Thermaflow 800	Polyester	" MIL-M-14E	"	12-24	70-75(B)	1.
THE BORDEN CHEMICAL CO. Resinite Dept.	Resinite EP-2, EP-14, EP-69C, EP-93C	Polyvinyl Chloride	ASTM D876 (3)	2,000-2,600		75-85(A)	1.21-
"	Resinite Hi-Heat 105, 105A	"	"	2,700		85(A)	1.26-
"	Resinite Super-Heat 125	"	"	3,000		92(A)	1.3
"	Resinite Vinyl Glass	"	"	2,000		75(A)	1.2
"	Resinite CT-1, CT-4, & CT-93 Tape	"	"	1,850-3,000		80	1.18-
"	Resinite EP-132, 105-A Cord	"	"	2,700-2,900		85-90	1.27-
"	Resinite EP-145 & Borden 5410	"	"	2,250		75	1.
CATALIN CORP. OF AMERICA	Catalin Nylon 95-1, 95-2, 85-1, 85-2	Nylon Type 6 (85-1,2- Type 6/6)	ASTM D635	11,300-12,000	0.9-1.2	118(R)	1.13-
"	Catalin Polyethylene 46-10, 20, 30, 40, & 50	H.D. Polyethylene	ASTM D635	4,000-4,600		70-72(D)	1.03-
CELANESE CORP. OF AMERICA	Fortiflex A70-12, A250-12, A500-12	Linear Polyolefin	ASTM D635	3,400-3,900	0.5-1.3	65(D)	1.
"	Celanese Acetate XFB-S to XFB-H4	Cellulose Acetate	ASTM D635	2,700-5,800	2.4-4.2	66-112(R)	1.
CIBA PRODUCTS CORP.	Ciba Araldite 6020	Epoxy	ASTM D635	12,000			
DIAMOND ALKALI CO.	Diamond PVC 500, 450, 40, 35, 30, 62 DX-70 – PASTE	Polyvinyl Chloride	ASTM D635 ASTM D568	6,000-9,000	0.4-1.0	110-120(R)	1.
THE DOW CHEMICAL CO.	Pelaspan 18	Polystyrene	ASTM D635				1.0-
"	Saran (All Commercial Grades)	Copolymer, Vinylidene Chloride–Vinyl Chloride	ASTM D635 ASTM D568	3,000-12,000	0.4-1.0	50-65(M)	1.
Du PONT	Rulan 2	Polyethylene	ASTM D635	1,500		55(D)	1.
DUREZ PLASTICS DIV. Hooker Chemical Corp.	Hetron 31, 32A 72, 92, 93LS, 103	Polyester	ASTM D635	5,900-9,600		35-55(R)	1.32
"	Durez 16771, 1308, 18683, 16274, 11864, 18975	Phenolic	ASTM D635 MIL-M-14F	5,000-7,000 (Min.)	0.26-15.0	90-113(M)	1.42
EASTMAN CHEMICAL PRODUCTS, INC.	Tenite Acetate Formula 061	Acetate	ASTM D635	3,000-6,400	1.5-3.1	72-113(R)	1.22
"	" 063, 067	"	"	2,300-6,300	1.4-3.3	50-113(R)	1.215
"	" 062, 066, 064, 070, 074	"	"	3,100-6,500	1.3-2.8	68-114(R)	1.22
ESCAMBIA CHEMICAL CORP.	PVC - 1250 & 1250E - 1225 & 1225E - 1200 - 1185	Polyvinyl Chloride (Rigid)	ASTM D635 ASTM D568 MIL-M-14F	8,000	0.5-0.7	117(R)	1.36
"	PVC Pearls-2250-3250 -2225-3225 -2200-3200 -2185-3185	Polyvinyl Chloride (Non-Rigid)		1,400-3,000		50-95(A)	1.15-
THE FIBERITE CORP.	Fiberite FM-1168	Modified Phenolic	ASTM D635	6,000	1.5		1.4
"	" 2485	Phenolic	"	7,000	2.1		1.4
"	" 2068F	Epoxy	"	6,000	0.30		1.
"	" [illegible]	[illegible]	"	[illegible]	[illegible]		

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ASTICS CHART OF SELF-EXTINGUISHING

DING COMPOUNDS

E TH F,	IMPACT NOTCHED IZOD AT 72°F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIFIC GRAVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STABILITY	COLORS AVAILABLE
	2.0		1.39	300 @ 250 psi		Excellent	Black or Brown
000	0.25-0.35	116-120(M)	1.47-1.52	245 @ 264 psi	Short time 300-400 Step-by-step 200-300	Good	Unpigmented Natural or Tints
000	"	118-124(M)	"	350 @ 264 psi	S.T. 300-400 S/S 250-300	"	Any
)	1.2	118 (R)	1.13	145 @ 264 psi	S.T. 420 S/S 370	"	White, Transparent & Others
00	0.25-12	60-80(B)	2.02-2.20	350-400 @ 264 psi	S.T. 350-400 S/S 300-350	"	Standard or Natural Grey
)	0.2	40-45(B)	1.45	114°C @ 264 psi	S.T. 370	Poor	
00	0.5-6.0		1.94-2.00	400 @ 264 psi	S.T. 170-370 S/S 170-300		Natural (off white)
000	0.26-0.9	90-100(E)	1.43-1.78	266-310 @ 264 psi	S.T. 320-430 S/S 220-300		Brown or Black
00	0.24-0.28	110 (E)	1.5	410 @ 264 psi	S.T. 310-330 S/S 220-230	Fair	All Translucent and Opaque
00	"	94-97(E)	"	266 @ 264 psi	S.T. 330-370 S/S 220-250	"	"
000	10-16	70-75(B)	1.8	450 @ 264 psi	S.T. 300 S/S 200-250	Fair	Standard Opaque
	12-24	70-75(B)	1.8	"	S.T. 300 S/S 245	"	"
600		75-85(A)	1.21-1.23		400-900	Fair to Good	Standard or Colorless Transparent
		85(A)	1.26-1.30		1,000	"	Transparent & Stndrd
		92(A)	1.34		1,000	Excellent	Black, White, Grey, Blue & Green
		75(A)	1.25		2,500-8,000	Very Good	Black or Yellow
00		80	1.18-1.25		350-1,200	Fair to Good	Black or Transparent
00		85-90	1.27-1.30		1,000	"	"
		75	1.21		400	Very Good	Black or as specified
000	0.9-1.2	118(R)	1.13-1.14	145-153 @ 264 psi	S.T. 420 S/S 370 Type 6	Fair	Wide Range
00		70-72(D)	1.03-1.04	150-170 @ 66 psi	S.T. 475-500	"	"
00	0.5-1.3	65(D)	1.04	170 @ 264 psi		Good	Opaque White & Black
00	2.4-4.2	66-112(R)	1.28	122-136 @ 264 psi	250-365	"	Trnsprnt, Trnslucnt, & Opaque Colors
)				145°C @264 psi			
00	0.4-1.0	110-120(R)	1.40	140-175 @ 264 psi 160-195 @ 66 psi		Fair	Natural
			1.0-30	180 @ 0 Load			"
000	0.4-1.0	50-65(M)	1.7	140 @ 250 psi 190 @ 60 psi 310 @ 0 Load	350-5,000	Satisfactory	Clear (Film) & Many Colors _ Monofilament
		55(D)	1.3		340-420	Good to Excellent	Natural, Black
00		35-55(R)	1.32-1.43	120-300 @ 250 psi	S.T. 365-392		Amber, Straw, or Pale Yellow
00	0.26-15.0	90-113(M)	1.42-1.88	270-600 @ 264 psi	S.T. 150-400 S/S 140-300(Min.)	Poor	Brown, Black, or Natural
00	1.5-3.1	72-113(R)	1.22-1.25	118-160 @ 264 psi 113-183 @ 66 psi	290-600	Excellent	Crystal-like clear transparent and unlimited range of transparent & translucent colors, variegations or mottles, and pearlescent and metallic effects
0	1.4-3.3	50-113(R)	1.215-1.25	112-158 @ 264 psi 128-183 @ 66 psi	290-600	"	
0	1.3-2.8	68-114(R)	1.22-1.25	117-165 @ 264 psi 137-193 @ 66 psi	290-600	"	
	0.5-0.7	117(R)	1.36-1.58	68 @ 264 psi 74 @ 66 psi		Good	Unlimited
00		50-95(A)	1.15-1.65			"	"
	1.5		1.43	390 @ 250 psi	S.T. 360	Fair	Black, Green
	2.1		1.42	325 @ 250 psi	S.T. 250	"	"
	0.30		1.86	266 @ 250 psi	S.T. 200	Good	All Opaque except white

MANUFACTURER	TRADE NAME AND NUMBER
AMERICAN POLYGLAS CORP.	Polyglas FR
"	Polyglas-Press She
THE BORDEN CHEMICAL CO. Resinite Dept.	Resinite EP-2
"	Resinite EP-14
"	Resinite EP-69C
"	Resinite EP-93C
"	Resinite Hi-Heat 1
"	Resinite Hi-Heat 1
"	Resinite Super-Hea
"	Resinite Vinyl Gla
"	Resinite CT-1 Tap
"	Resinite CT-4 Tap
"	Resinite CT-93 Ta
"	Resinite EP-132 C
"	Resinite 105-A Co
"	Resinite EP-145 a Borden 5410
CONTINENTAL-DIAMOND FIBRE CORP.	2346 FR Dilecto
"	GB-28E FR Dilect
"	GMP-100 Dilecto
"	GMP-200 FR Dilec
"	CF-FR Dilecto
"	XF-FR Dilecto
"	X-13 FR Dilecto
"	XX-13 FR Dilecto
"	XXP-14 FR Dilect
"	XXXP-31E FR Dil
THE DOW CHEMICAL CO.	Saran (All Commercial G
Du PONT	Teflon TFE & FE
"	Zytel 101
"	Zytel 31
THE FORMICA CORP.	Formica Grade FF
"	Formica Grade XX
"	Formica Grade EP
"	Formica Grade FF
THE GLASTIC CORP.	Grade UTR Resist
"	Grade UTS
"	Grade UMM
"	Grade GF
MOBAY CHEMICAL CO.	Merlon-Natural
MONSANTO CHEMICAL CO.	Opalon 1406
"	Rigid Ultron R402
NATIONAL VULCANIZED FIBRE CO.	XX-326
"	Pyronil
"	EP-491
"	XXXP-475
PITTSBURGH PLATE GLASS CO.	Selectron 5113
"	Selectron 5041
ROHM & HAAS CO.	Plexiglas 5009
"	Plexiglas 5009B
SPAULDING FIBRE CO,. INC.	Spauldite Sheet Grade MLE
"	Spauldite Sheet

NG PLASTICS MATERIALS

FILM, SHEETING, LAMINATES

NAME MBER	TYPE OF RESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F, PSI	IMPACT NOTCHED IZOD AT 72°F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIFIC GRAVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STA-BILITY	COLORS AVAILABLE
	Unsaturated Polyester	UL Test	10,000-12,000	6.5-9.0	90-95(M) 45-55(B)	1.33-1.37			Excellent	Light Green & Clear
ss Sheet	"	"	20,000-23,000	9.0-12.0	100-105(M) 55-60(B)	1.48-1.52			Good	White, Black, Grey as Specified
2	Polyvinyl Chloride	ASTM D876	2,600		85(A)	1.23		900	Fair	Transparent and Standard
14	"	"	2,200		80(A)	1.21		800	Good	"
69C	"	"	2,500		75(A)	1.21		900	"	"
93C	"	"	2,000		75(A)	1.22		400	"	Colorless Trnsprnt
leat 105	"	"	2,700		85(A)	1.26		1,000	Fair	Transparent and Standard
leat 105A	"	"	2,700		85(A)	1.30		1,000	Good	"
r-Heat 125	"	"	3,000		92(A)	1.34		1,000	Excellent	Black, White, Grey, Blue or Green
l Glass	"	"	2,000		75(A)	1.25		2,500-8,000	Very Good	Black or Yellow
l Tape	"	"	1,850		80(A)	1.22		850	Good	Black
4 Tape	"	"	3,000		80(A)	1.25		1,200	Fair	Transparent
93 Tape	"	"	1,850		80(A)	1.18		350	Good	"
132 Cord	"	"	2,900		90(A)	1.27		1,000	Fair	Transparent or Black
A Cord	"	"	2,700		85(A)	1.30		1,000	Good	"
145 and	"	"	2,250		75(A)	1.21		400	Very Good	Black or as specified
cto	Phenolic	ASTM D635	20,000	.67	112(M)	1.42		S/S 165		Red
Dilecto	Epoxy	"	46,000	18	114(M)	2.10		S.T. 550		Natural
cto	Polyester	"	15,500	14.5	95(M)	1.83		S.T. 525		Natural, Red or Green
Dilecto	"	"	15,000	13.5	100(M)	1.80		S.T. 475		"
to	Phenolic	"	10,000	2.2	100(M)	1.36		S.T. 70		Red
to	"	"	9,700	1.0	45(M)	1.31		S/S 400		"
cto	"	"	20,000 (Avg.)	55	108(M)	1.38		S/S 500		Natural, Red or Black
lecto	"	"	16,000	.4	108(M)	1.36		S.T. 700		"
Dilecto	"	"	16,500	.45	105(M)	1.38		S.T. 720		Natural
R Dilecto	Epoxy	"	12,000	.7	100(M)	1.43		S/S 70		"
cial Grades)	Copolymer, Vinylidene Chloride—Vinyl Chloride	ASTM D635 ASTM D568	3,000 unoriented, 10,000-12,000 oriented	0.4-1.0	50-65(M)	1.7	140 @ 250 psi 190 @ 60 psi 310 @ 0 Load	350 - 1/8" Thick 5,000—1 Mil Film	Satisfactory (if stabilized)	Film-Clear, Monofilament—Many
& FEP	Fluorocarbon	ASTM D635 ASTM D568 MIL-M-14F	1,500-6,000	3.0	75-95(J)	2.13-2.20	140 @ 264 psi 250 @ 66 psi	500-600	Good	Wide Range
	Polyhexamethylene Adipidamide	ASTM D635 ASTM D568	11,800	0.9-2.0	118(B)	1.14	150 @ 264 psi 360 @ 66 psi	385	"	"
	Polyhexamethylene Sebacamide	"	8,500	0.6-1.6	111(B)	1.09	135 @ 264 psi 300 @ 66 psi	410	"	"
de FF-60	Melamine	ASTM D635	32,000	10.0		1.90		60	Good	Natural Brown
de XX-68	Modified Phenolic	"	13,000	.45		1.36		60	Fair	Red
de EP-37	Epoxy	"	20,000	.40		1.45		80	Good	Natural Cream
de FF-55	Melamine	"	32,000	10.0		1.90		23	"	Natural Brown
Resistrac	"	UL Test	10,000	8.0	50+(B)	1.84	300 @ 264 psi	400	Good	Red(Gold Cast)
	"	"	10,000	8.0	60+(B)	1.85	"	400	Fair	Red
	"	"	12,000	10.0	60+(B)		"	400	"	Tan
	"	"	15,000	14.0	60+(B)		"	500	"	Grey
al	Polycarbonate	ASTM D635 ASTM D568 ASTM D1692(5)	8,000-9,500	1.5-16.0		1.2	135°C @ 250 psi 138°C @ 60 psi	S.T. 440	Excellent	Standard
	Polyvinyl Chloride	UL Test	2,800		93(A)	1.38			Excellent	Natural-White & Black or as specified
R402	PVC Copolymer	ASTM D 635	6,050	0.65		1.52				White Opaque
	Modified Phenolic	UL Test NEMA TEST (4)		.05	115(M)	1.35		S.T. 750	Excellent	Red
	Vulcanized Fibre	"	8,000-15,000	1.53-1.75		1.26		S.T. 75	"	Red, Black & Grey
	Epoxy	"		.63	102(M)	1.43		S.T. 880	"	Natural Cream
	Modified Phenolic	"		.36-.44	106(M)	1.33		S.T. 805	"	Natural Tan
13	Polyester	ASTM D635	15,000-19,000	10.0-13.0	1.56				Poor	Light Straw
41	"	"	52,000	20.0	1.95				"	"
909	Acrylic	ASTM D635	7,900	0.4	61(M)	1.22	149 @ 264 psi 172 @ 66 psi	540	Good	White Translucent
909B	"	"	9,500	0.3	77(M)	1.24	165 @ 264 psi 183 @ 66 psi	400	"	Colorless Transparent
eet E	Melamine	ASTM D635	14,000	1.1	106(M)	1.38		S.T. 480 S/S 355	Good	Milky White
eet	"	"	35,000	13.5	123(M)	1.90		S.T. 800	"	"

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								128-18
"	" 062, 066, 064, 070, 074	"	"	3,100-6,500	1.3-2.8	68-114(R)	1.22-1.25	117-16 137-19
ESCAMBIA CHEMICAL CORP.	PVC - 1250 & 1250E - 1225 & 1225E - 1200 - 1185	Polyvinyl Chloride (Rigid)	ASTM D635	8,000	0.5-0.7	117(R)	1.36-1.58	68 @ 26 74 @ 66
"	PVC Pearls-2250-3250 -2225-3225 -2200-3200 -2185-3185	Polyvinyl Chloride (Non-Rigid)	ASTM D568 MIL-M-14F	1,400-3,000		50-95(A)	1.15-1.65	
THE FIBERITE CORP.	Fiberite FM-1168	Modified Phenolic	ASTM D635	6,000	1.5		1.43	390 @ 2
"	" 2485	Phenolic	"	7,000	2.1		1.42	325 @ 2
"	" 2068F	Epoxy	"	6,000	0.30		1.86	266 @ 2
"	" 6100	Phenolic.	"	9,000	4.0		1.96	340 @ 2
"	" FM-17610	"	ASTM D635 MIL-M-14F	9,000	4.0		1.66	350 @ 2
FOSTER GRANT CO., INC.	62 ASK, 62 BSK, 62A, 62B, 62BE	Nylon	ASTM D 635	11,900	1.4	112(R)	1.14	165 @ 2 385 @ 6
"	61A, 61B, 61ASK, 61BSK	"	"	12,100	1.2	118(R)	1.14	175 @ 2 390 @ 6
"	64A & B	"	"	9,500	2.5	107(R)	1.14	250 @ 2 330 @ 6
"	BK40F, BK40T	"	"	11,700	0.9	119(R)	1.13	165 @ 2 390 @ 6
FURANE PLASTICS, INC.	Epocast H-1196	Epoxy	ASTM D635 ASTM D568	8,000	0.4		1.40	170 @ 2
"	" H-1140	"	MIL-M-14F	9,000	0.45		1.50	230 @ 2
GENERAL ELECTRIC CO.	G-E General Purpose Phenolic	Phenolic	ASTM D635 MIL-M-14F	6,000-7,500	0.28-0.34	96-104(M)	1.35-1.42	300-35
GENERAL ELECTRIC CO. Chemicals Materials Dept.	Lexan	Polycarbonate	ASTM D635	8,000-9,000	12-16	118(R) 70(M)	1.20	280-29 283-29 285-29
GERING PLASTICS	Formula 262 MH	Cellulose Acetate	ASTM D635	5,200-5,500	4.3	101(R)	1.28	60°C
"	Flame Retardant Linear Polyethylene	Linear Polyethylene	"	3,400-3,800	0.8	48(R)	1.15	158 @
"	Flame Retardant Polypropylene	Polypropylene	"	3,800-4,200	0.4	98(R)	1.08	195 @
B.F. GOODRICH CHEMICAL CO.	Geon 8750	Polyvinyl Chloride (Normal Impact)	ASTM D568	7,000	0.80	80(D)	1.38	157 @
"	Geon 8700A	Polyvinyl Chloride (High Impact)	ASTM D635 MIL-M-14F	6,000	15.0	80(R)	1.35±.02	157 @
W.R. GRACE & CO.	Grex C-1007, C-1008	Polyethylene	ASTM D635	4,600		72(D)	1.04	170 @
"	" C-1010, C-1011, C-1012	"	"	4,000		70(D)	1.03	150 @
INTERCHEMICAL CORP.	IC-636 F.R.	Polyester	ASTM D635			50-55(R)	1.28	77°C
"	IC-670 F.R.	"	"			"	1.235	90°C
"	IC-1549 F.R.	"	"				1.17	
MARBON CHEMICAL DIVISION Borg Warner Corporation	Cycolac	Acrylonitrile, Butadiene, Styrene	ASTM D635	5,500	8	100(R)	1.20	137 @ 155 @ 188 @
MELAMINE CORPORATION	Melamine 2015	Melamine	ASTM D635 MIL-M-14F	6,500	1.2		1.48	175°C
MESA PLASTICS CO.	Diall 50-52, 51-60 52-40-40, 52-70-70	Diallyl Ortho-Phthalate	MIL-M-14E	5,500-8,000	0.4-7.0		1.39-1.85	290-39
"	Diall FS-10, FS-60, FS-80	Diallyl Meta-Phthalate		6,500-9,500	0.4-10.8		1.68-1.86	420-49
MOBAY CHEMICAL CO.	Merlon-Natural	Polyester	ASTM D635	8,000-9,500	1.5-16		1.2	135°C 138°C
MOL-REZ DIVISION American Petrochemical Corp.	Pleogen 2118	Polyester	ASTM D635					
NAUGATUCK CHEMICAL DIV. U.S. Rubber Co.	Vibrin 144D	Polyester	ASTM D635	9,000	2.2 (Cast Resin)	119(L)(Cast Resin)	1.41	82°C
PHILLIPS CHEMICAL CO.	Marlex Polyolefins	Polyethylene & Ethylene Butene-1 Copolymer	ASTM D635 ASTM D568	3,800-4,200	0.5-3.0	40(R)	1.04	165-1 255-26
PITTSBURGH PLATE GLASS CO.	Selectron 5113	Polyester	ASTM D635	6,000	0.20-0.40	110-115(M)	1.35	99°C
"	Selectron 5041	"	"	6,000	.22	113(M)	1.37	85°C
THE POLYMER CORP.	Teflon TFE (Du Pont)	Fluorocarbons	ASTM D635	1,000-3,500		55-65(D)	2.1-2.3	
"	Nylon 66 (Du Pont)	Nylon	"	10,000-14,000	1.0	118(R)	1.14	150 @
"	Nylon 6 (Various Mfrs.)	"	"	11,000-12,000	1.0	112(R)	1.1	150 @
"	Lexan (GE)	Polycarbonate	"	9,000-10,000	12-16	118(R)	1.2	300 @
"	Penton (Hercules	Polyether	"	6,000	0.4	100(R)	1.4	185 @
REICHHOLD CHEMICALS, INC.	L-135-60 Becksol	Alkyd	MIL-R-21417				1.01	
"	Polylite 8063	Polyester	ASTM D635 ASTM D568	9,500	0.4-0.6	45-50(B)	1.31	230 @
SPENCER CHEMICAL CO.	Nylon 6	Nylon	ASTM D635	At 73°F 9,600-12,800	At 73°F 0.8-3.6	101-119(R)	1.12-1.14	
WESTINGHOUSE ELEC. CORP. Component Products Dept.	53836GG	Polyester	NEMA TEST (4)	6,000	0.2	65-70(D)	1.5	104°C

1. Scales: E, J, L, M, & R – Rockwell; A & D – Shore Durometer; B – Barcol.
2. Denotes Underwriters Laboratory flammability test for 1/8" thick specimen.
3. Denotes tentative ASTM method of testing non-rigid vinyl chloride polymer tubing.
4. Denotes proposed NEMA Switchgear Committee test.
5. Denotes recent tentative ASTM
6. Denotes SPI 45° flammability t
7. Denotes flammability test prop

28-185 @66 psi			lucent colors, variegations or mottles, and pearlescent and metallic effects
17-165 @264 psi 37-193 @66 psi	290-600	"	
8 @ 264 psi 4 @ 66 psi		Good	Unlimited
		"	"
90 @ 250 psi	S.T. 360	Fair	Black, Green
25 @ 250 psi	S.T. 250	"	"
66 @ 250 psi	S.T. 200	Good	All Opaque except white
40 @ 250 psi	S.T. 85	Fair	Green
50 @ 250 psi	S.T. 90	"	Black, Natural
65 @ 250 psi 85 @ 60 psi	S/S 400	Fair	Range of
75 @ 250 psi 90 @ 60 psi	S/S 400	to	Translucent
50 @ 250 psi 30 @ 60 psi	S/S 350	Good	and Opaque
65 @ 250 psi 90 @ 60 psi	S/S 410		Clear— Translucent
70 @ 250 psi	400	Good	Unlimited
30 @ 250 psi	400	Fair	Unlimited
00-350 @250 psi	250-350	Poor	Black, Brown
80-290 @264 psi 83-293 @66 psi 85-295 @0 Load	S.T. 400	Good	Unlimited
0°C @ 264 psi		Stable	Unlimited
58 @ 66 psi		Good	Wide Range
95 @ 66 psi		"	"
157 @ 264 psi	S.T. 1413	Excellent	"
157 @ 264 psi	S.T. 1085	"	"
170 @ 66 psi	S.T. 500 1/8"	Fair	Wide Range
150 @ 66 psi	S.T. 500 1/8"	"	"
77°C @ 264 psi			Clear
90°C @ 264 psi			"
137 @ 264 psi 155 @ 66 psi 188 @ 0 Load		Good	Wide Range
175°C @ 250 psi	S.T. 260	Good	Wide Range (Opaque)
290-392 @264 psi	350-430	Excellent	Black, Blue, Grey, Green or White
420-490 @264 psi	370-400	"	Brown or Green
135°C @250 psi 138°C @60 psi	S.T. 440 1/8"	Excellent	Standard
82°C @250 psi	365		Natural or Pigmented
165-175 @66 psi 255-260 @0 Load			Most Translucent Colors
99°C @264 psi		Poor	Light Straw Pigmentation Possible
85°C @264 psi		Poor	"
	400	Excellent	Wide Range
150 @ 250 psi	350	Poor	Natural, Blk & Whte
150 @ 250 psi	250		Natural, Black
300 @ 250 psi	350		
185 @ 250 psi	400	Poor	Natural, Olive Drab
-		Good	Pigmented, as desired
230 @ 264 psi	400	Poor	Clear, can be Pigmented
	S.T. 440-500 S/S 320-440	Good	Wide Range
104°C @264 psi	385		Red & White

ASTM test for flammability of plastic sheeting and foam.
ility test for film .004" thick and greater.
proposed by Cellular Plastics Div. of SPI.

NATIONAL VULCANIZED FIBRE CO.	XX-326	Modified Phenolic	UL NEM
"	Pyronil	Vulcanized Fibre	
"	EP-491	Epoxy	
"	XXXP-475	Modified Phenolic	
PITTSBURGH PLATE GLASS CO.	Selectron 5113	Polyester	AST
"	Selectron 5041	"	
ROHM & HAAS CO.	Plexiglas 5009	Acrylic	AST
"	Plexiglas 5009B	"	
SPAULDING FIBRE CO,. INC.	Spauldite Sheet Grade MLE	Melamine	AST
"	Spauldite Sheet Grade G-5-766	"	
"	Spauldite Sheet Grade MCE	"	
"	Spauldite Sheet Grade X-748	Phenolic	AST
"	Spauldite Sheet Grade EXXXP-810	Epoxy	AST
SYNTHANE CORP.	FR-1	Phenolic	AST AST MIL-
"	FR-2	"	AST AST
"	FR-3	Epoxy	
"	G-5	Melamine	
"	G-10FR, G-HFR	Epoxy	MIL-
TAYLOR FIBRE CO.	GSC	Silicone	AST AST
"	G-5	Melamine	
"	Fireban 321	Phenolic	
"	XY-1	Epoxy	
UNION CARBIDE PLASTICS CO. Division of Union Carbide Corp.	Krene KDA-2006	Polyvinyl Chloride/ Vinyl Chloride-Vinyl Acetate Copolymer	CS-1
"	Krene KDA-2007	"	
"	Krene VCA-3354	Vinyl Chloride—Vinyl Acetate Copolymer	AST
WESTINGHOUSE ELECTRIC CORP. Component Products Dept.	Glass Mat 13047-1	Polyester	NEMA
"	Glass Mat 13047-2	"	
"	Glass Mat 44763BC	"	
"	Micarta Plate Tan, 20220	Phenolic	

MANUFACTURER	TRADE NAME AND NUMBER	TYPE OF RESIN USED	TES PASS
THE DOW CHEMICAL CO.	Styrofoam 33	Polystyrene	ASTM
Du PONT	Teflon TFE & FEP	Fluorocarbon	ASTM ASTM MIL-M-
HOOKER CHEMICAL CORP.	Hetrofoam 10	Alkyd	ASTM SPI Te (7)
"	Hetrofoam 14	"	"
"	Hetrofoam 16, Hetrofoam 17	Alkyd (16) Semi-Prepolymer (17)	"
KOPPERS COMPANY, INC. Plastics Division	Dylite Expandable, Type S-40	Polystyrene	ASTM D
MOBAY CHEMICAL CO.	Rigid & Flexible Polyurethane, (Various Mfrs.)	Polyester	ASTM D ASTM D

ed Phenolic	UL Test NEMA TEST (4)		.05	115(M)	1.35		S.T. 750	Excellent	Red
nized Fibre	"	8,000-15,000	1.53-1.75		1.26		S.T. 75	"	Red, Black & Grey
y	"		.63	102(M)	1.43		S.T. 880	"	Natural Cream
fied Phenolic	"		.36-.44	106(M)	1.33		S.T. 805	"	Natural Tan
ster	ASTM D635	15,000-19,000	10.0-13.0	1.56				Poor	Light Straw
"	"	52,000	20.0	1.95				"	"
ic	ASTM D635	7,900	0.4	61(M)	1.22	149 @ 264 psi 172 @ 66 psi	540	Good	White Translucent
"	"	9,500	0.3	77(M)	1.24	165 @ 264 psi 183 @ 66 psi	400	"	Colorless Transparent
ine	ASTM D635	14,000	1.1	106(M)	1.38		S.T. 480 S/S 355	Good	Milky White
"	"	35,000	13.5	123(M)	1.90		S.T. 800 S/S 600	"	"
"	"	11,500	1.4	107(M)	1.38		S.T. 440 S/S 355	"	"
lic	ASTM D635	19,000	.51	110(M)	1.38		S.T. 430 S/S 370	Fair	Red
	ASTM D635	20,000	.55	111(M)	1.48			Good	Milky White
lic	ASTM D635 ASTM D568 MIL-M-14F	16,000	0.4	105(M)	1.36		S.T. 500	Satisfactory	Natural Tan
"	ASTM D635 ASTM D568	12,400		105(M)	1.32		S.T. 470	"	"
	"	20,000	0.5	105(M)	1.5		S.T. 450	"	Natural Buff
ine	"	37,000	7.0	120(M)	1.9		S.T. 260	"	Natural Grey
	MIL-M-14F	35,000	7.0	110(M)	1.85-1.90		S.T. 450	"	Natural Green
ne	ASTM D635 ASTM D568	23,000	6.5	100(M)	1.85		400		White
ine	"	37,000	6.0	120(M)	1.9		350		Natural
lic	"	13,000	.40	115(M)	1.33		600		Maroon
	"	20,000	.50	108(M)	1.49		600		Pale Yellow
inyl Chloride/ Chloride-Vinyl te Copolymer	CS-192-53 (6)	2,300			1.244 (Natural)		850	Fair	Clear, Translucent and Opaque
"	"	"			1.248 (Natural)		850	"	Opaque and Translucent
Chloride—Vinyl te Copolymer	ASTM D568	8,000 (Avg.)	.50		1.35-1.36		S.T. 425 (Avg.)	"	Translucent White
ster	NEMA TEST	12,000	8.0				400		Red
"	"	9,000	8.0				400		"
"	"		8.0				S.T. 400		"
lic		16,500	1.001				760		Tan

FOAMS

TYPE OF ESIN USED	TESTS PASSED	TENSILE STRENGTH AT 72°F. PSI	IMPACT, NOTCHED IZOD AT 72°F FT-LB/IN OF NOTCH	HARDNESS (1)	SPECIFIC GRAVITY	HEAT DISTORTION POINTS °F	DIELECTRIC STRENGTH V/M	LIGHT STABILITY	COLORS AVAILABLE
yrene	ASTM D635				1.7-2.2	160 @ 0 Load			Blue
carbon	ASTM D635 ASTM D568 MIL-M-14F	1,500-6,000	3.0	75-95(J)	2.13-2.20	140 @ 264 psi 250 @ 66 psi	500-600	Good	Wide Range
	ASTM D635 SPI Test (7)	35			Controllable between 2.0 and Approx. 20 pcf			Poor	White
"	"	"						"	"
(16) Prepolymer (17)	"	"			Controllable between 2.0 and Approx. 6.0 pcf			"	"
yrene	ASTM D1692	33-121	0.14-0.21						
ster	ASTM D635 ASTM D1692	15-30 Flexible 15-1,000 Rigid			1.5-3.0 Flexible 1.0-60 Rigid	Approx. 200°C @ 0 Load		Fair to Poor	Wide Range

Here are the first commercial Delrin applications

With Du Pont's Delrin acetal plant just coming on stream, the first of the almost 100 applications that had been tooled up for and tested months ago in anticipation of the material's introduction to the industry have just now started to come to market.

Because of the interest which the plastics industry has in any such new and exciting material—particularly at the point where the cold figures on a data sheet are at last starting to get translated into commercial realities—the editors of MODERN PLASTICS have interviewed a number of the manufacturers involved and picked out six of the more outstanding new Delrin products. Each of these products is illustrated here and for each the manufacturer's reasons for and reactions to the use of the material are summarized.

Molded one-piece part replaces costly assembly

The tensile strength, dimensional stability, and low moisture absorption of acetal resin helped in the effective solution of a tricky problem faced by design engineers at The Lionel Corp., New York, N. Y. The part under consideration was the small coupler (A in the illustration) inserted at either end of the company's model trains, and the problem was to design a piece that would either eliminate or simplify the tedious—and costly—assembly job required for the conventional-type coupler. Previously, assembly consisted of inserting with a tweezer a small metal compression spring along one side of the metal coupler and then fitting the two pieces into a slot in the truck frame on the undercarriage. The company decided to try for a one-piece plastic part incorporating a molded-in thin, semi-rigid projection (see arrow in the photo at right) that would function as an integral leaf spring.

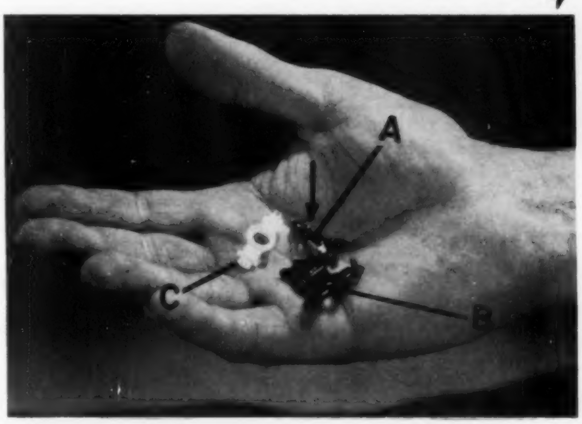
After some none-too-successful experiments with other plastics, company officials finally hit upon acetal resin as the one material that would not only provide the essential springiness required in the part but would not deform (and lose its spring value) during the effective life of the model trains.

Lionel design engineers also used the new materials' properties in the model train's truck frame (B) and bolster (C); again they adhered closely to the concept of designing assembly features directly into the plastic part. The truck frame, for example, despite its relatively small size, incorporates a molded-in plank with projections, on which "floating" springs fit; free-spinning, cone-pointed journals; and a projecting lug which fits into a matching molded-in hole in the coupler to facilitate the assembly operation.

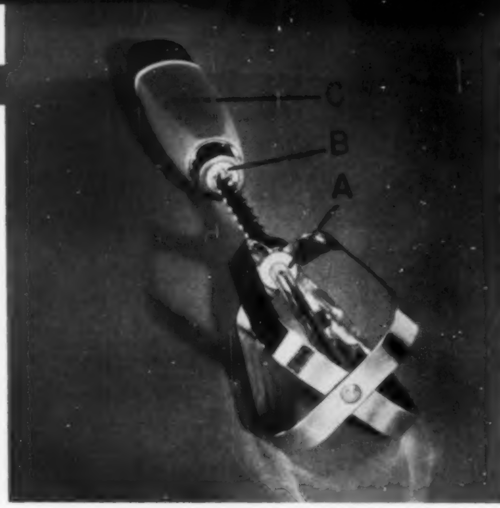
Also designed in acetal is the axle, where the added advantage of a low coefficient of friction comes into the picture.

The coupler is molded by Gries Reproducer Corp., New Rochelle, N. Y.; the other parts are molded in Lionel's plant in Irvington, N. J.

For five more applications, turn page



One million cycles—and no wear



Three key parts—almost small enough to be overlooked but vital to the performance of a new type of egg beater being marketed by Ekco Products Co., Chicago, Ill.—have made the switch from metal to acetal with an improvement in performance.

Because of the unique construction of the egg beater, these three parts—a bearing (A in photo), a bushing (B), and a retainer (C, not visible)—are subjected to considerable wear. The beater itself operates on the same principle as a child's top. When the user pushes down on the handle, the screw action spins the beater; on release, the beater spins back and returns the handle to the normal position.

In the original design, the three components were fabricated of metal and included: 1) a stamped brass bearing at the point where the spiral shaft enters the handle and where operational stress is the greatest; 2) a machine screw brass bushing which is located below the ferrule where the beater section is joined with the shaft; and 3) a cold rolled steel retainer (also a machine screw part) located inside the handle and acting as a pivot for the beater shaft.

In each instance, the switch to acetal showed a definite improvement. For one thing, the low coefficient of friction of the acetal provided a smoother and quieter operation and greater durability. In a test program the beater was run to a total of 1 million cycles (about 250 operational hours) and discontinued when the acetal parts showed no wear.

It was also discovered during the test program that despite the fact that the upper end of the beater shaft is threaded and pointed like a twist drill where it presses up against the acetal retainer, the retainer showed no apparent damaging effects.

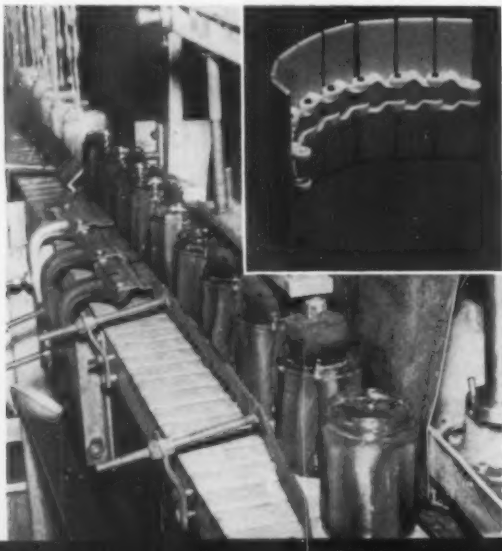
A final benefit was derived from the fact that the self-lubricating acetal bearing had no harmful effect on the sparkling chrome-finish of the metal parts. In contrast, the friction created by a shaft passing through a brass bearing would ultimately wear away the shaft plating and invite corrosive action.

Although savings in manufacturing costs, if any, have not yet been determined, the company is still willing at this early date to state that acetal "has made it possible for us to produce a superior product at no increased costs to us."

The parts are molded by Vulcanized Rubber & Plastics Co., Morrisville, Bucks County, Pa.

Service life doubled, costs halved

As a complement to steel and nylon chain, acetal should find one of its largest volume markets in the conveyor belt field. Fenco Inc., Chicago, Ill., has had belts out in the field and under test ever since it received pilot plant samples of acetal resin two years ago; so far, there have been no complaints or any serious performance defects despite the fact that the chains have been used under the most rigorous conditions. As just one example, an acetal conveyor was set up about a year ago in the Croswell Pickle Co. plant in Croswell, Mich. (See photo below.) In operation, corrosive pickle brine (acetic acid, salt, and sugar) at 170° F. was run over the conveyor belt. To date, the chain has not warped, lost any rivets, or stretched and has only discolored very slightly to a light pale yellow.



In comparison to metal chains, the acetal product has a life 2 to 4 times that of steel and costs 40 to 50% less than stainless steel chain; it can be run with or without lubricants and, in fact, has a lower coefficient of friction running dry than steel does when lubricated; it will not scratch the bottoms of cans and cause them to rust; it can run at speeds that rubber chains or belts can never attain and because of its light weight (one-tenth that of the metals used) and resiliency can even run materially faster than high-speed stainless stell belts; and, finally, it is not only easier to assemble acetal parts together, but molding costs work out much lower than the cost involved in machining steel.

As compared to nylon for the same type of application, acetal absorbs about one-tenth the water; has one-sixth the stretch; is one and one-half times stiffer; and is three times harder to deform under load. Reportedly, a number of manufacturers other than Fenco now have acetal conveyor belt chains under test, and it seems logical to assume that this may be the first of the major markets in which acetal will assume a prominent position.

The chain is molded for Fenco by DuBois Plastic Products Co., Buffalo, N. Y.

From forty machines to four

According to Coast Foundry & Mfg. Co., La Verne, Calif., the economies inherent in switching from brass sand castings to molded acetal for the top and bottom parts of a ballcock valve and for the valve shank were sufficient to pay completely for the installation of molding machines and the cost of the dies needed to run the parts. As outlined by Coast Foundry, savings showed up in the following areas:

1) Instead of the 40 machines that were previously needed to make brass castings to the proper tolerances, the company now has only four machines for precision molding of the acetal parts.

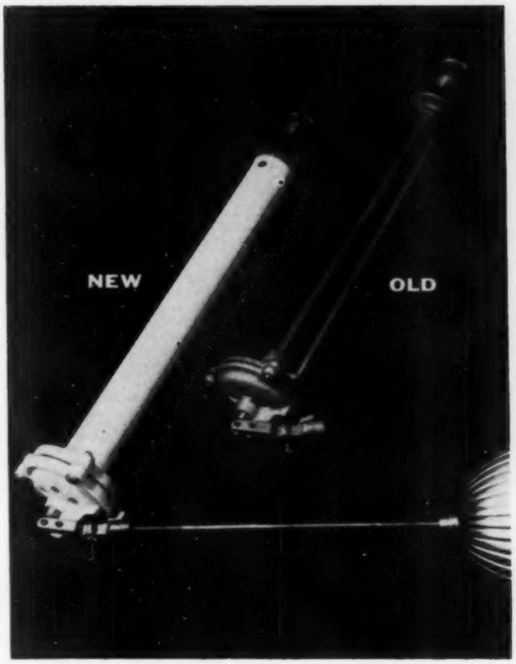
2) Because acetal is nine times lighter in weight than brass, freight savings were considerable.

3) Precision molding, as opposed to casting and machining, insures uniformity in parts—with a consequent reduction in rejects. Interchangeability of parts is also facilitated.

4) By cutting down production and finishing steps, labor costs have been markedly reduced.

In addition to the savings, the company reports that the acetal performs also more effectively than the brass parts since it is absolutely resistant to rust, corrosion, and abrasives. Thus, not only has the cost been lowered but the company feels it now has a better product.

Parts are molded by Coast Crafts Industries, Glendale, Calif.



Corrosion problems completely eliminated

In the design and construction of fishing reels, manufacturers have long considered it inevitable that "to obtain the physical properties needed for good performance at *low cost,* you have to sacrifice corrosion resistance by using materials, susceptible to the ravages of salt water, namely metals.

Now however, if the results reported by Zebco Co., Tulsa, Okla., on their use of molded acetal reel components are any criteria, this need no longer be. It is Zebco's contention that in the performance qualities expected of a fishing reel, the strength, rigidity, dimensional stability, and heat resistance of acetal approach those of some of the metals now being used for reels—with the added plus of outstanding corrosion resistance.

Within the past two months, Zebco has placed on the market its Models 88 and 99 "reel-n-rods," in which the body of the reel, the front cover, and the back cover are all molded of acetal. Assembled together with several stainless steel parts, the plastic reel is now being proudly advertised as "100% salt-water proof."

The company has already had excellent reception to the plastics reels in the field and is currently considering using the material in a variety of other items in their line.

Molding of the Zebco 99 is done by Continental Plastics Inc., Oklahoma City, Okla., and the Zebco 88 is molded by Ajax Co., Tulsa, Okla.

Savings of close to 60%

The first invasion of acetal into a product line characterized traditionally by an all-brass construction is a faucet marketed by Kel-Win Mfg. Co. Inc., Richmond, Va. The plastic part is an internal valve mechanism vital to the performance of the unit.

Because of the unique design of the valve, which makes it impossible to impart manual squeeze on the seat or valve body when using the faucet, it was decided that plastics materials might be suitable for the part. According to the company, the two prime reasons for finally choosing acetal were the facts that a) the material has practically no moisture absorption and b) that the strength of the plastic is sufficient to meet the predictable loads (based on maximum water pressures) which the part would encounter. Other advantages **(To page 191)**

COLANDER molded of 100% linear polyethylene by Loma Plastics Inc. withstands boiling and cold water.

SELF-STACKING vegetable bins can be arranged from floor to ceiling, if desired. Each compartment is a separate unit with bottoms that slope from back to front, so contents will always "flow" forward. Molded by Rubbermaid Inc. of 100% linear PE. (Photo, Rubbermaid Inc.)

What to watch for in molded

Here is the consensus on the best densities and melt indexes to use, and what is being done to overcome the stress crack problem

STEP-ON garbage or trash can is molded in two pieces by Loma from 100% high-density PE.

The photos appearing on these pages represent a cross section of housewares items molded from high-density polyethylene.

In these applications the term "high-density" does not always indicate that the item is molded from 100% linear or low-pressure processed PE. In several instances the product is molded from a blend.

The blends vary according to the desire of the molder. They may be mechanically mixed blends of virgin linear and conventional PE, or they may contain portions of off-grade material in either or both linear and conventional PE. The molder may buy his material from a compounder or do his own mixing and dry coloring. The idea is primarily to obtain a stiffer material than conventional PE, but a material that will provide comparatively good flow so that short-time molding cycles can be maintained and items stripped easily from the core if there is an undercut. The density which is most often sought in these blends ranges from 0.930 to 0.940.

What to do about stress cracking

The density most often used in 100% linear molded housewares is around 0.950. Several of the low-pressure PE producers are struggling mightily to convince molders and the latters' customers that they should insist on 100% high-density (linear) to insure most desirable

DIAPER CAN, 22 in. high and 12⅜ in. square, is molded by Dapol Plastics Inc. from a blend of high-density and conventional PE. Replaceable liner is of PE film.

SET OF THREE MIXING BOWLS is molded of 100% high-density material by Plastray Corp.; lids are of conventional PE. Bowls and lids double as cake keeper and server. (Photos, unless otherwise indicated, W. R. Grace & Co., Polymer Chemicals Div.)

high-density PE housewares

properties of stiffness, surface finish, and heat resistance. When a finished item is to be boiled, the resin used should be capable of withstanding 212° F. for at least 5 minutes. To obtain this degree of heat resistance a 100% high-density resin is generally necessary.

A major problem in high-density molded housewares has been environmental stress-cracking. This condition can be the result of strains produced in molding which act on the molded piece to leave tiny cracks after exposure to certain chemicals or atmospheres. Stress-cracking is less likely to occur in a high-density material with a high molecular weight and a low melt index, such as 2.0. But this type of material is more difficult to mold. Consequently, producers of linear PE frequently offer a material of 4.0 to 6.0 melt index that is generally accepted as a copolymer. This compound generally has properties acceptable for housewares molding.

Conventional PE resin used for housewares often has a melt index of 18.0 or 20.0 which results in fast flow. But melt indexes of conventional and linear PE are never comparable, and conventional PE is much more flexible and softer than linear in any case. This difference helps to explain, of course, why a blend of the two materials is sometimes desirable. An ideal material for large items would be an 8 to 12 M.I. linear PE that would give high shock impact resistance at low temperature, good flow, and little danger of stress-cracking. Such a material is now in research.

Mold design and strain

Another step in minimizing strained products has been the addition of more gates to the mold. This prevents long flow into any area of the mold and thus helps to reduce strain. A mold for a large garbage can may have six instead of the one gate used for conventional PE. The two-piece step-on can illustrated on the facing page has three gates on the outside molding and four gates on the inside molding. Seventeen gates were counted on a 12 by 7 by ½-in. perforated PE cutlery tray at a counter display of PE items.

Most important factor in correcting stress-cracking for molded items is proper molding, according to PE producers. They will advise a molder on correct material temperatures and mold temperatures, and also the proper mold design for high-density PE. Adequate machine size and mold temperature controls produce quality parts in high-density PE. Each mold must be considered by itself if adaptable.

A distributor of plastics housewares reports that high-density PE items are now moving in increasing quantity and that he has had no breakage return. He expects a big volume increase within the next few months.—End

GROWING FAMILY of building plastics is distributed by Dow through a network of exclusive distributors that is completely separate from the company's molding powder sales program. At left is saran-based flashing installed about a plumbing vent; in center, PE film is laid down as moisture barrier; at right, foamed polystyrene insulation is bonded to asphalt-coated roof.

How to distribute specialized plastics

Second article in series traces channels through which specialty products flow, delineates patterns and sizes of the various markets involved

What system of distribution is best for the manufacturer of specialized plastics components such as flat or corrugated reinforced sheeting, sandwich panels, decorative and industrial laminates, foam insulation for the construction field, and polyethylene film for agricultural and construction applications? Should a manufacturer set up his own independent group of distributors, or utilize distributors who are already servicing his markets?

There are no pat answers to these questions; each product presents a different set of problems, and each manufacturer has his own way of dealing with them. However, it is possible to study the distribution patterns already established by typical leading manufacturers and to point out some of the basic trends now shaping up.

An earlier article (MPl, Oct. 1959, p. 81) dealt mainly with the distribution of sheets, rods, tubes, and components for producing glass-reinforced plastics. In this second article, attention is centered mainly on plastics which move heavily into the do-it-yourself construction, architectural, and building markets.

The multiple-distribution set-up

Among the predictions made in the previous article by a prominent plastics distributor was one to the effect that, within the next 10 years, non-ferrous and specialty steel warehouses would expand into distribution of plastic sheets, rods and tubes, and that plastics material suppliers would develop a "multiple" distribution pattern to reach the building and agricultural markets. Already, Dow Chemical Co. markets its fast-growing line of building industry products, including Polyfilm poly-

ethylene film, Saraloy 400, a saran-based sheet flashing material, Scor-bord expanded styrene perimeter insulation, and Roofmate roof insulation through a group of strategically located exclusive distributors. These are the same firms whose efforts were previously limited to distributing of Dow's Styrofoam expanded styrene material.

Another distinct possibility is that as certain plastics components become more firmly entrenched in the building and construction field, their manufacture and/or distribution will be taken over by large companies already having an important stake in this field. For example, Masonite Corp. recently announced that it would take over the sales and distribution of the sandwich component panels with expandable styrene core, which were developed by Koppers Co. Inc. and first used in the NAHB Research House of 1958 at South Bend, Ind. (see MPl, March 1959, p. 100). After details are completed, Masonite will offer the Dylite exterior and interior panels as a substitute for conventional framing. They will then be distributed as a jobber-warehoused product and sold through lumber dealer outlets.

Distribution via the lumber yard

The trend to suburbia, the growth of leisure time available to many wage earners, and the booming popularity of "do-it-yourself" projects have placed the lumber dealer in a strategic position as a potential plastics distributor.

Last available census figures show that in 1956, there were 30,177 lumber dealers in the U. S. Their total annual sales, at $8,313,000,000, marked an average of $275,575 per dealer. Comparable figures for 1948 indicated a total of 26,110 dealers with total sales of $5,172,050,000, or an average of only $196,363 per dealer.

In a recent survey sponsored by the National Retail Lumber Dealers Association in cooperation with *American Lumberman and Building Products Merchandiser*, the 2101 lumber dealer respondents reported operation of 3652 retail lumber and building products retail outlets. Twenty-nine lines and 119 types of products were covered by the survey.

This study revealed that 44.4% of the responding dealers sold plastics. About 34.5% sold plastic insect screening (as against 66.9% for aluminum, 54.2% for bronze and 61.9% for

Decorative laminates

By Jack Alexander*

Almost all decorative Formica is sold through our network of more than 80 independent distributors, who maintain more than 110 warehouses in many marketing areas throughout the U. S. This, however, is only the first step in making the product available to our vast consumer public. Decorative laminate, while it is a finished product, is, nevertheless, a raw material. Before it achieves its ultimate purpose, it must be attached to a table, or counter top, or wall. To meet this situation we have established, over the years, a complete marketing organization.

When decorative laminates leave the factory, they go into the distributor organization. The distributors, and their wholesale jobbers, in turn, distribute either to retail sheet dealers or direct to fabricators. Our sheet dealers are the lumber, flooring, or building material outlets, who sell to builders and contractors. The bulk of our material, however, reaches the consumer through residential as well as commercial fabricators. The balance of the material goes through the furniture manufacturers. The distributor, of course, occupies a key position. He is, in essence, the funnel through which the material passes on its way from the plant to the user.—End

*Manager, Public Relations, Formica Corp., subsidiary of American Cyanamid Co.

steel wire screening). Over 34% sold plastic laminates; 20% said they handled plastic pipe. Vinyl tile was sold by 50.4% and vinyl-asbestos tile by 54.5%. Under the general heading of wall and ceiling coverings, 33.8% reported that they sold "plastic paneling"—type not known.

Dealers reported that they got the major share of their sales from contractors and home-owners in about equal proportions (approximately 39%), with farm trade next (13.8%), and commercial concerns last (8.1%).

In an earlier survey covering 1000 lumber dealers, 78.7% of the respondents said that they were acquainted with the growing use and the various applications of polyethylene film in the building field. At that time, 63.9% of those sampled said they were selling the film; virtually 100% of the others stated they intended to handle it in the future. Principal customers for the film, as listed by the dealers, included contractors (57.7%); home owners (38.5%); carpenters (32.4%), and farmers (31.5%). Principal uses included covering for materials on the job, as a vapor barrier, and as a covering for work in progress.

Sizing and packaging aid distribution

With more and more plastics panels, pipe, and other products moving directly into the hands of the public as do-it-yourself materials,

CORRUGATED RP sheet (on patio roof) and flat panel (in back of knickknack shelf at left) are developing their own distribution channels. One major supplier (Filon) now reaches 15,000 lumber and building supply dealers through a network of 100 distributors.

manufacturers may well give increased attention to proper sizing and convenient packaging. Filon's pre-cut reinforced plastic glazing panes, more fully discussed below, are a step in the right direction. Strongly to be avoided is anything resembling the complex and confusing sizing system which has traditionally hampered the lumber industry.

Industrial-type distributors, such as those covered in the previous article, do not in general service the building industry, but concentrate on industrial users. Industrial suppliers usually sell at the same prices to anyone, basing cost differences on quantity alone. The building industry, on the other hand, has distinct purchasing channels. Cost differences are mainly a function of the identity of the purchaser and, to a much lesser extent, the quantity involved.

In addition, the distribution of qualified types of plastics to the construction field presents many problems because of local building code restrictions, lack of adequate knowledge about plastics on the part of many architects, contractors, etc., and relatively poor communication between plastics manufacturers and the construction field.

One organization, which in 1953 was organized to fill this gap, is Architectural Plastics Corp., Eugene, Ore., presently serving the 11 western states and Texas. Today this company, which has been called the prototype of a possible "new breed of plastics distributor," is an integration of five companies offering services in research and development, fabrication and manufacturing, distribution, chain retailing, specialized services to prime contractors, and international developments.

Under its corporate name, APC conducts what it describes as the world's largest comprehensive wholesale distribution of plastic building materials. This program directs plastic building materials of all types to a wide variety of building materials retailers, including lumber yards, glass and glazing firms, roofing and sheet metal establishments, interior decorators, wall and floor covering dealers, and others. The building industry's thirst for new contemporary materials and technologies is indicated by the corporation's sales increase of 100 to 200% per year for each year that it has been in operation.

Through a division, Construction Plastics, a specialized marketing program oriented to the needs of prime general contractors is conducted. General contractors throughout the

country may purchase all APC materials and products directly through this division at specified contractor prices. Prices are f.o.b. closest APC warehouse, manufacturing plant, or job site, depending upon commodity and volume. Materials which must be marketed as applied processes, such as sprayed-on vinyl sheeting, shell and plate structures, etc., are also made available through this division. Chain retail services for this field are conducted under Plasti-Products Co., "the lumber yard for plastics," while a manufacturing division, Design Industries, was formed in 1956 to facilitate the use of specialized materials and services.

A fully developed distribution system

Of all the types of plastics used in the building and construction field, the decorative melamine laminates probably enjoy the highest degree of acceptance by the industry. Having proved themselves through the years in counter tops, bathroom vanities, as wall coverings, and in numerous other applications, they have won the enthusiastic approval of architects and builders. Meanwhile, producers of melamine laminates have developed some of the most effective distribution set-ups being used for any type of plastic components.

An accompanying panel, p. 105, describes the distribution pattern followed by Formica. Spokesmen of the company point out that purchasers of their products are many people in different walks of life. They may or may not have the title of purchasing agent, but for all practical purposes that is what they are—builders, architects, housewives, or fabricators. The company also has many large fabricating customers in the appliance and furniture field, who are sold directly through the Formica sales organization. The problem is how to reach a varied group of potential buyers and to maintain good service to fill material requirements in any part of the country at all times.

Distributors are usually located in large metropolitan areas, from which their salesmen service present and potential customers. Since service to outlying areas is generally infrequent, the company encourages its distributors to set up wholesale jobbers in those areas. Independent fabricators—who, of course, also work with competitive brands and materials—have grown from a mere handful to more than 10,000 at present.

Close liaison is maintained between the parent organization and its distributors. Recently top officials of Formica addressed the company's national distributors over a closed circuit radio hookup in conjunction with National Home Week, explaining the company's plans for concentrated promotion to the public of home builders' model homes. Distributors in 89 major cities heard the details simultaneously at their local NBC stations.

Plastics building materials

By George Hermach*

We feel that most plastics that relate to the building industry have been marketed as specialty building products and sometimes thrown to the wolves, resulting in price selling which eventually took all of the profit out of some very fine products. Price selling also quickly forces the producers to cheapen and adulterate the product to the point where it becomes completely ineffective. This has been true very clearly in the case of corrugated sheeting, which is only now beginning to re-establish its price and its quality after a rather disheartening five-year period.

We believe that plastics as a class of building materials require the same kind of specialized distribution as other classes of building materials. It is somewhat more difficult since plastics are not such specific items as the metals, masonry, plumbing, and electrical products. They are really very flexible materials and when considered in their entirety they encompass a range of physical properties that exceed all other building materials combined, and that are as infinitely variable as the market chooses to make them.

*President, Architectural Plastics Corp.

RP sheet distribution

In the field of flat and corrugated reinforced plastic sheeting—relatively a much newer and less familiar product—an outstanding distribution job is being done by Filon Plastics Corp., El Segundo, Calif. Filon maintains sales offices and warehousing facilities in key marketing areas throughout the country, and its products are moved to approximately 15,000 lumber and building supply dealers through a network of more than 100 distributors.

Most of Filon's distributors include lumber, building material, and glass dealers, enabling the company to reach the industrial, commercial and residential field in an (To page 192)

Economy drapes have

Priced to cover an 8- by 8-ft. wall for approximately $2, polyethylene curtains promise high style at low cost to institutional and home users

To hotel and motel owners, managers of hospitals, cafeterias, and also to home owners, quality drapes have always spelled expense in purchase and in maintenance. This expense has been compounded by the trend in modern decoration towards ceiling-to-floor, wall-to-wall draperies with big patterns and dimensional designs to simulate spaciousness.

If the purchaser can't stand the cost of high-style fabrics, he is forced to buy products that are admittedly cheap—and look it—because of frequent pattern repeats.

Now, through the development of wide printing and embossing equipment, Hartford Textile Corp. has introduced Wallscapes, which is a new concept of polyethylene drapery materials priced to be replaced after reasonable use. Yet, as our four-color cover picture proves, they are designed to look and feel like rich, hand-screened textile drapes.

Widths up to 140 inches

Using Visking polyethylene film, and inks from Interchemical Corp., the company prints by rotogravure on film widths up to 140 in., probably the widest plastic web ever printed. Up to four colors are used, including metallics. Then the printed film is pressure embossed on extra-wide equipment of Hartford's own design, and cut to widths either 36 in. or 42 in. and to panels 90 in. long.

While various film thicknesses are used for different price brackets, a typical panel in 0.0015-gage material retails for 49 cents.

A 36-in. panel, sold to a drapery manufacturer, may be either rod-pocketed or finish pleated, depending on style required and end-product price at retail. But, aside from the value added by fabrication into drapes, the 49-cent-per-panel base cost would bring the cost of material for a wall 8- by 8 ft. to about $2, since, by draping, the 36-in.-wide film would cover 2 ft. of wall. Even by using the material more densely, the base cost would be a little less than $4.

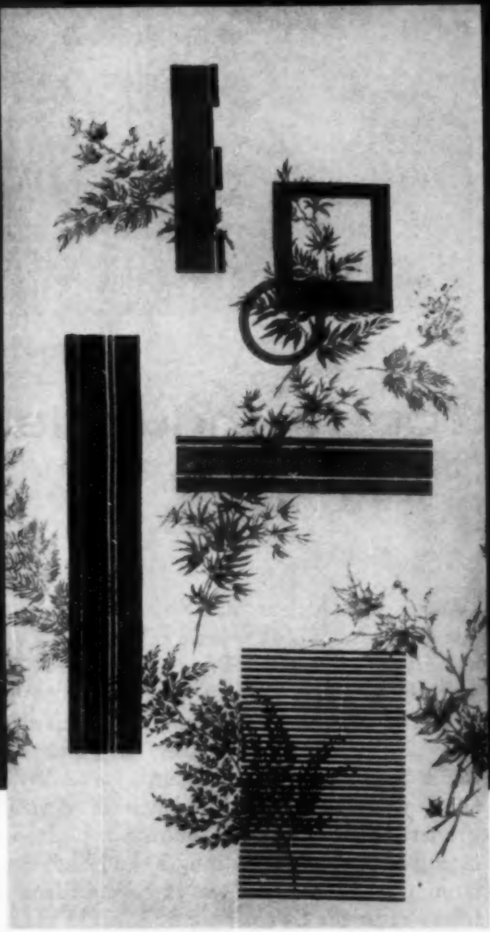
According to Hartford's stylist, Miss Shirley Reichmann, the keys to this new development lie in the opportunity to create new elements of styling and to achieve dimension through extra wide embossing and printing.

The patterns are large, sophisticated, and sometimes exotic; the colors brilliant or subdued to suit the designs. The names of the patterns are also worth noting: Sparta (Greek motif), Sumara, Rose Garden, Arpeggio (Modern), Pom Pom, Birchwood and Magnolias, Trafalgar (London motif), Gallerie (Wisteria on a gold grill), Venetian Balcony.

Plant capacity for the production of this line is to be doubled by the end of 1959, and arrangements are being made for its manufacture by Oplex, S.A., Mexico, D. F., and Oxford, S.A., Buenos Aires, Argentina.—End

THE COVER: Fully pleated PE drapes, Sumara pattern, lend air of glamour to modern room setting. Wallscape in turquoise, gold, black, and white. Photo by King-Weese Studios. Drapes were made by Dorothy Curtain Co. Inc. Rug, courtesy Bigelow-Sanford Carpet Co. Inc. Furniture and setting, courtesy Widdicomb Furniture Inc.

quality look



THREE OF THE PATTERNS currently offered: Top left, Rose Garden, in red, pink, and turquoise combinations. Bottom left, Sparta, in olive, brown, and blue combinations. Directly above, Arpeggio, in turquoise-ultramarine, persimmon-brown, and pink-red combinations. Enlargement of circled portion in Arpeggio pattern shows details of texture of drapes.

*13, *14 in a series

EVERYBODY NEEDS EPOXIES

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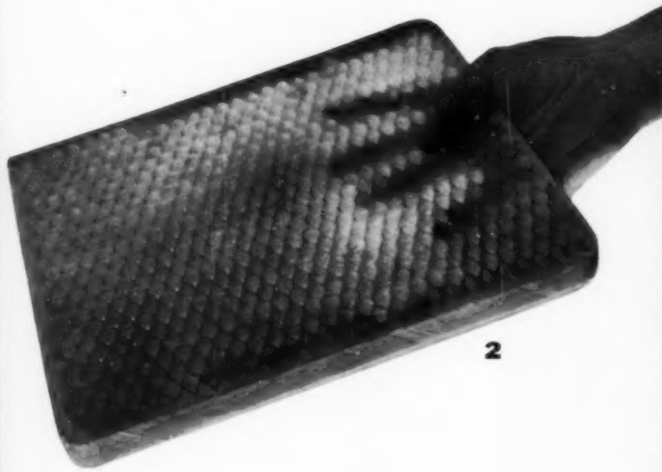

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Tops in industrial adhesives

By Bernard Gould*

Epoxies, as a class, offer an extremely versatile spectrum of high specific adhesion to a wide variety of different adherend surfaces. They provide excellent bonds to plastics of all types, to metal, ceramics, and a host of other materials as well. Their cure mechanism and their combination of strength and internal flexibility result in an exceptional balance of desirable properties in an industrial adhesive: high shear strength, high impact strength, and high creep strength. These adhesives have excellent internal strength comparable to molded plastics and, in general, comparable to that of most other materials being bonded. This high strength exists in the cured bond regardless of whether the original formulation was 100%-reactive or solvent-dispersed.

Volume shrinkage, in properly modified epoxies, can be cut to less than 0.5% resulting in the virtual elimination of internal stresses in the bonded joint and in a high order of adhesion. The availability of these formulations as 100%-solids materials means superior void-filling characteristics and the use, where required, of thick glue lines without weakening bonds. Here are some typical uses (numbers link to accompanying illustrations).

1. Linings made of cementable Teflon are bonded to centrifuge of stainless steel. Two-component epoxy system cures at room temperature, requires only contact pressure to effect the bond. Exposed metal fasteners cannot be used since they would provide a route to corrosion via liquid diffusion.

2. Not only the cross-linked or reinforced thermosetting plastics, but many thermoplastics as well, cannot be bonded to other materials or to themselves by heat-sealing or by thermal welding techniques. A specially formulated 100%-reactive solvent-free formulation

*Manager, Market Development, Rubber & Asbestos Corp., Bloomfield, N. J.

is used for bonding resin-impregnated honeycomb panel with a partially thermoplastic acrylic and a load-bearing structural sandwich.

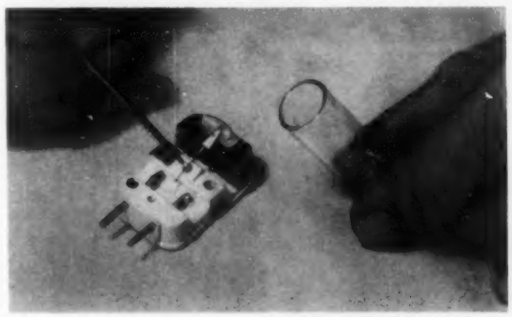
3. Where brittle rigid plastics or thin flexible films are used, the possibility exists that they may not be strong enough to bear reasonable loads at a pierced hole which would be caused by a conventional fastener because of stress concentration. In the Fairchild Recording Equipment Co., 220 playback cartridges less than 1 in. sq. Mylar film, aluminum, mumetal, sintered iron, Alnico magnets, Kralastic, 0.001 in. copper wire, rubber, and silver-plated brass are bonded together with a solvent-dispersed, 60% solids formulated epoxy adhesive, which dampens vibration.

4. Adhesive-bonding is often the only practical method of bonding dissimilar plastics or plastic to metal, wood, or other materials. For example, an epoxy adhesive is used to seal terminal posts into cell case tops of batteries, such as those used for emergency aircraft communications, where miniaturization is becoming increasingly important.

5. A single-component epoxy-based adhesive is a logical replacement of silver solders for this model train under-carriage, manufactured by Lionel Corp. Alnico magnets are bonded to die-cast zinc and the thixotropic (no-run, no-sag) nature of the adhesive has left a smooth joint. (Close-up at left in 5.)

6. Epoxy adhesives have tensile strengths up to 8000 p.s.i., with virtually no fall-off in shear strengths at 180° F., good creep resistance and impact strength. They can also be modified to enhance their peel strength and flexibility. Their internal flexibility is high enough to permit bonding components with widely different coefficients of expansion. For example, they can be used to bond aluminum channels to glass panes in the manufacture of double-pane insulating windows. In the honeycomb sandwich illustrated, scrim cloth, impregnated with high-strength modified epoxy adhesive, is on inside areas of two outer sections. The specially formulated adhesive has an excellent flow factor which makes it creep out and fillet the voids between skin and core, retaining its strength when heat starts to build up.

Unlike other plastic-bonding, curing adhesives, mere contact pressures are sufficient to effect the bond during the cure cycle. Formulations are sold in a variety of physical forms and possible cure cycles for almost any production setup. Epoxy adhesives are available in supported film form; in lump form to be



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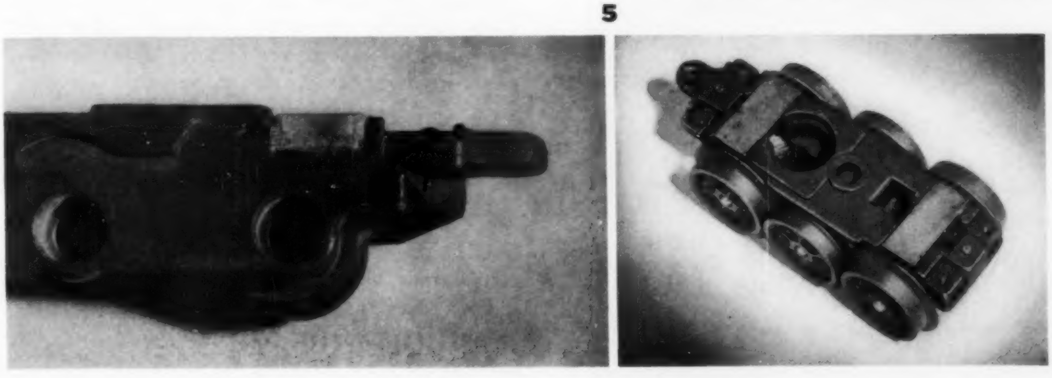

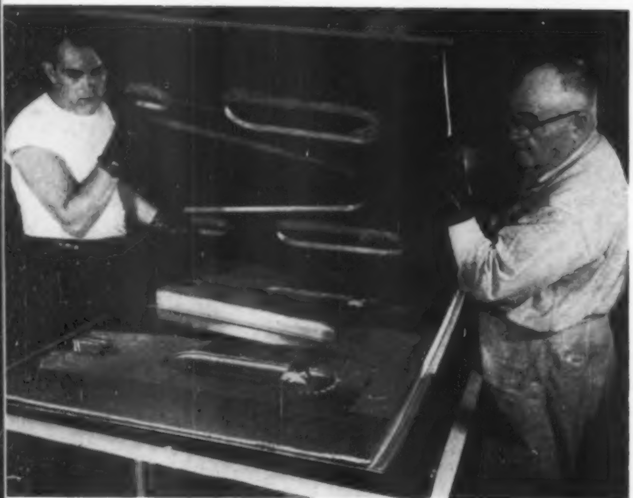

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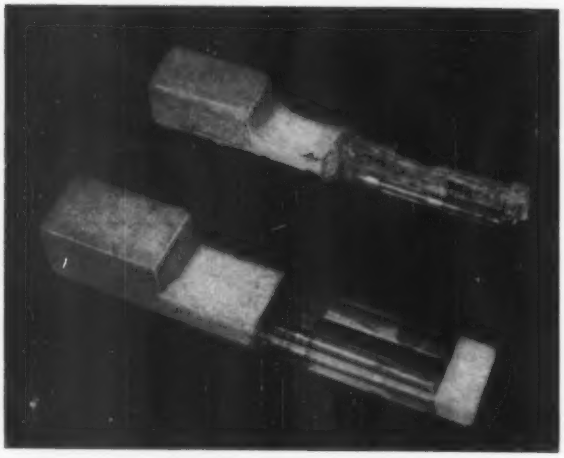

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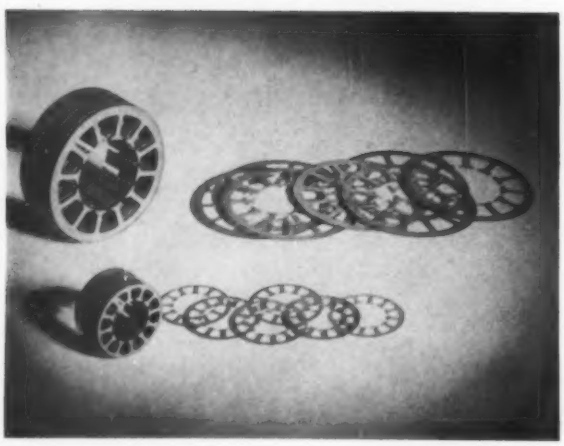

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heated and applied to the surface as a hot melt; powder form to permit "dusting" on wide, flat surfaces; as one-component, solvent-free paste adhesive systems, which must be heat cured to develop cohesive strength but which may be used directly from the container; and as two-part, solvent-free systems in viscosities ranging from heavy, trowelable reinforced pastes to free-flowing liquids. Sprayable viscosities are offered in 100% solids concentration or in high-solids-content solvent solutions.

Epoxy-based adhesives can be formulated with suitable modifiers and curing agents to achieve greater or lesser degrees of impact strength, peel strength, flexibility, and similar characteristics or physical properties which might be specified for a particular application. The 100%-reactive modified epoxy adhesives offer a distinct advantage when working with plastics which must not be exposed to many of the solvents normally used in other adhesive families. This eliminates danger of attack on susceptible plastic foams or other critical surfaces. Epoxy adhesives are unique in that the cure takes place without the formation of "by-products," such as the condensation cure of phenolic resins in which water is released. This results in such economies as bonding right after adhesive application; elimination of laborious, costly high-pressure equipment; less shrinkage in the glue line which contributes to the high adhesion to the substrate.

7. Bonds made with properly formulated epoxy adhesives feature excellent resistance to weather and to most chemicals, acids, and alkalies. The epoxy-to-acrylic butt joint shown before (bottom) and after (top) immersion in a methylene chloride solution indicates that the bond was relatively unaffected by the bath, even though parts of the two materials being bonded were severely attacked.

8. Formulated epoxy adhesives are good thermal and electrical insulators. They have high surface resistivity, excellent dielectric strength, and low power factors. Metal laminations in motor construction are first sprayed with a solvent-dispersed epoxy adhesive, then assembled and heat-cured to produce laminated stacks. The dissimilar metals shown here —beryllium copper, Mykroy, and stainless steel —are joined without metallic corrosion.

While in other industries epoxies have been considered as "high-performance, specialty usage" adhesives, to the plastics industry they are becoming the work horses for many different general purpose bonding applications.—**End**

ADHESIVE-COATED copper is shown being curled back over a printed circuit. Copper foil used is generally 1 to 2 oz./sq. ft. in weight; at least 99.5% pure.

Printed circuits

By Herbert R. Levine*

While other laminates may be superior to epoxies in certain specific properties, none of them present such a broad range of desirable characteristics: high flexural and tensile strengths, very low moisture absorption, good dimensional stability, superior resistance to aging, good machinability, good bond to copper circuit foil—these are the most important mechanical properties which characterize copper-clad epoxy laminates.

To these mechanical properties is added a wide range of electrical properties, which are retained to a high degree even after exposure to moisture: low dissipation factor at low and high frequencies; high dielectric strength; good insulation resistance; and low dielectric constant; and finally, in addition to these mechanical and electrical properties,[1] epoxy laminates possess high resistance to the chemical action of the fluxes, solvents, etchants, plating solutions, and molten solders used in the fabrication of printed circuits.

Copper-clad epoxy-glass laminates

The choice of resins, curing agents, and additives used in the manufacture of copper-clad epoxy-glass laminates is dictated by the nature of the application and by the manufacturing process. Shelf life of the pre-impregnated glass cloth (pre-preg) is important to the laminator, and is a limiting factor in the choice of any particular system. The bulk of these laminates is made by the dry lay-up method. In this process, tack-free pre-preg is stacked in the requisite number of plies, surfaced on one or both sides with copper foil, sandwiched between polished metal pans, and pressed at pressures varying between 200 to 1500 p.s.i., and temperatures of from 120 to 175° C. The pre-preg is produced by applying a solution of the resin formulation to a woven alumina-lime-borosili-

*Laminated Products Dept., Chemical & Metallurgical Div., General Electric Co., Coshocton, Ohio.

[1]For specific property values in support of claims made here, see Laminates Chart, p. 548 of *Modern Plastics Encyclopedia Issue for 1960*.

cate glass cloth. The resin content, the degree of solvent retention, and the degree of polymerization of the pre-preg; pressure; temperature; rate of temperature rise; and time are variables which the laminator controls to determine the properties of the laminate.

One such property which has been receiving ever-increasing emphasis is retention of mechanical properties at elevated temperatures. Evidence of this emphasis is NEMA's establishment this year of epoxy-glass laminate grade G-11, which differs from G-10 in only one respect: retention at 150° C. of at least half the flexural strength at room temperature.

Epoxy-glass laminates are not inexpensive; the glass fabric used is costly and, of the popular thermosetting resins used in laminates, only the silicones exceed the epoxies in price. Cost reductions which are achieved by the use of copper-clad epoxy laminates result from much higher orders of reliability, or from properties which permit the use of printed circuits in the place of hand-soldered and assembled point-to-point wiring. A real saving in weight, where missile and rocket components are begrudged an extra ounce, can be realized from epoxy-glass laminates' flexural strengths, which range from 60,000 p.s.i. upward, with tensile and impact strengths to match.

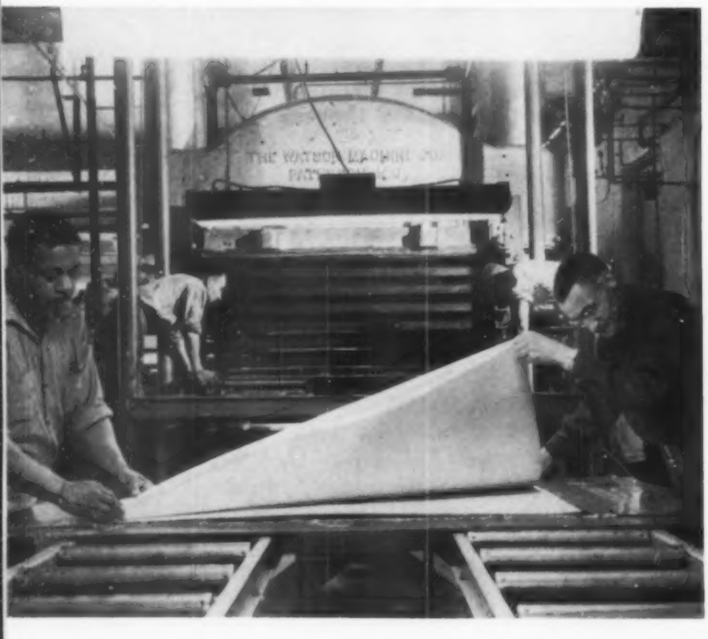
Where a given strength requirement for a circuit board has been established, it can be met by epoxy-glass laminates with a one-third weight savings. Where the applications permit, inert extenders may be used.

To improve flexibility, internal plasticizers are used to a limited extent. Chlorinated additives, usually reactive, are occasionally incorporated in resin formulations to render self-extinguishing the normally slow-burning but flammable epoxy laminates.

Epoxy-paper laminates

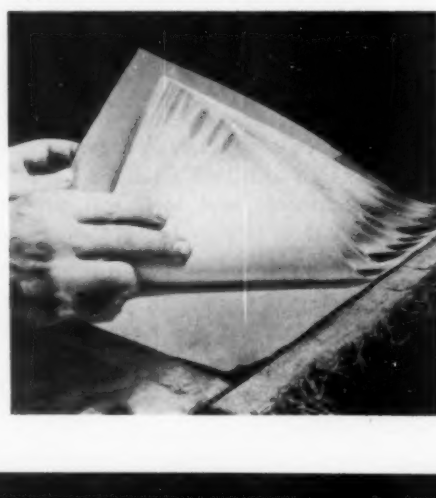
Worthy of special mention are a relatively new copper-clad class, the epoxy-paper laminates. These materials offer moderate cost, can be punched when cold, and because of epoxies' tolerance for and re-activity with chlorinated compounds, are self-extinguishing. Paper's economy and machinability are coupled with epoxies' superior electrical characteristics and low moisture absorption to produce products which surpass NEMA XXXP grade in "wet" electrical properties. Copper foil used is generally 1 to 2 oz./sq. ft. in weight and at least 99.5% pure. Foil properties of significance to the laminate user are number and size of pinholes, dents, and scratches; lead inclusions, thickness uniformity, and quality of bond.

In printed circuit laminates, the same base material and epoxy resin can be combined to produce many different laminates, which can be varied to meet many uses.—**End**



CONSTRUCTION of the sandwich is from the bottom up. Here, sheets of resin impregnated paper are positioned on the adhesive side of electrolytic sheet copper. When finished, the assembly is inserted into the heated press (background) for curing and final lamination.

ADHESIVE-COATED COPPER is on top and bottom in this close-up. Resin impregnated paper is in between. Printed circuits can be made with a copper-clad base on one or both sides.



SWIMMING POOL in Ashland, Ore. is enclosed in polyester film "bubble." To fabricate the structure, lengths of film are heat-sealed together. Airlock door, right, retards air escape.

Where airhouses pay off

Two instances involving the use of nylon-reinforced heat-sealable polyester film in the construction of air-supported buildings dramatize the economic advantages they bring to the user. In both cases the "bubbles" were fabricated by G. T. Schjeldahl Co., Northfield, Minn., from Scotchpak nylon-reinforced polyester film manufactured by Minnesota Mining & Manufacturing Co. (3M).

Since starting to work with the film, the company has covered over 1 million sq. ft. for permanent structures, and expects to cover another million sq. ft. over the next two years. Cost is said to be almost $1 per sq. ft., or about $3 less than for the cheapest conventional building construction. Electricity requirements to furnish enough air pressure to keep an average size structure (30 by 60 ft.) at full contour reportedly come to less than 1¢ per hour.

How pool owners profit

At Harold's Pony Express Lodge, Sparks, Nev., the polyester bubble over the lodge's heated swimming pool is credited with 50% reduction in maintenance cost resulting from the elimination of leaves and other airborne debris from the water. In addition, the time during which the pool is open has been lengthened from a previous four months to a year.

Another pool, Twin Plunge, Ashland, Ore., reports a reduction in heating costs from $9 to $4 per day by using a polyester film covering.

In both installations, the coverings can be taken down if desirable. Total weight of a 30- by 60-ft. structure is approximately 200 lb., and the film can be compactly folded, making it convenient and easy to store.

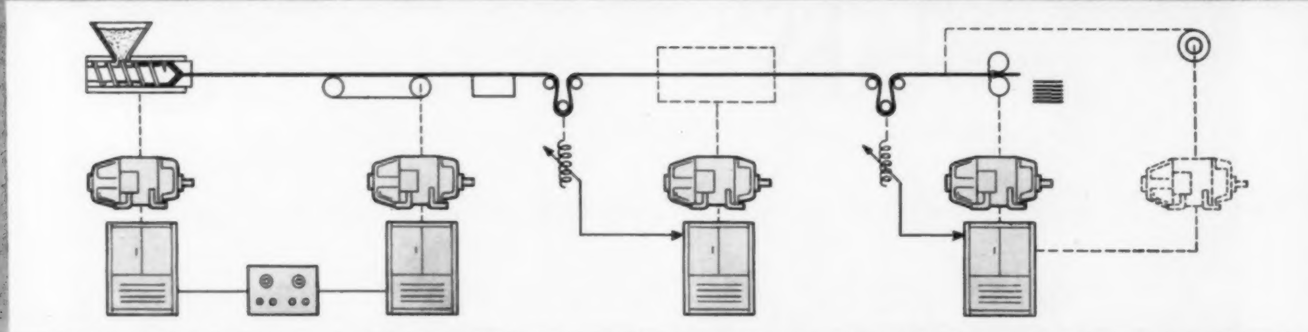
Florist reaps advantage

A 50% cut in heating bills, an increase of over 20% in business, and nearly 100% elimination of insects and debris resulted in switching from glass to the new film for greenhouses. These were the benefits reported by Hallstrom & Son Co., Redwing, Minn. Previously, wooden posts were needed for glass supports which often decayed from moisture. These posts are no longer needed, making the greenhouse easier to use. The film, 12 mils thick when reinforced with nylon fibers, is claimed to admit more ultra-violet light than glass normally used for this application, which is said to be a factor in healthier plant growth.

An unusual application has been reported by Space Structures Inc., Minneapolis, Minn. The company is currently erecting rigid buildings by inflating the polyester bubble, spraying on concrete or similar material, and, once the structure has rigidified, collapsing the airhouse for subsequent use.

In all, it looks as if airhouses, whether built with reinforced polyester film, vinyl-coated nylon, or polyethylene film are proving their utility in a wide area of end uses and may be expected to become an increasingly important factor in the plastics industry.—End

General Electric Extruder Drives Offer Greater Efficiency



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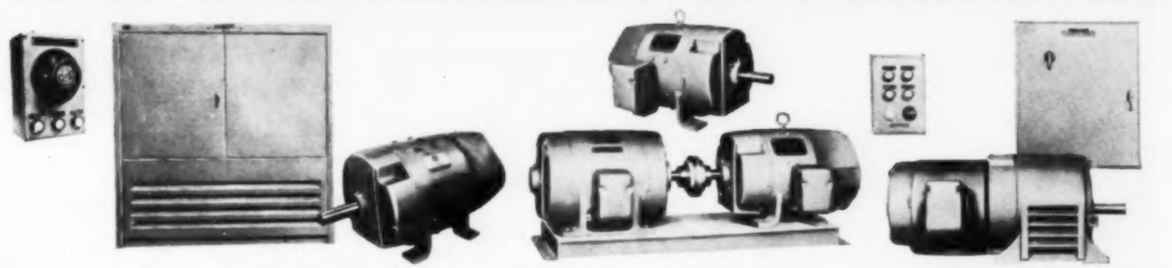

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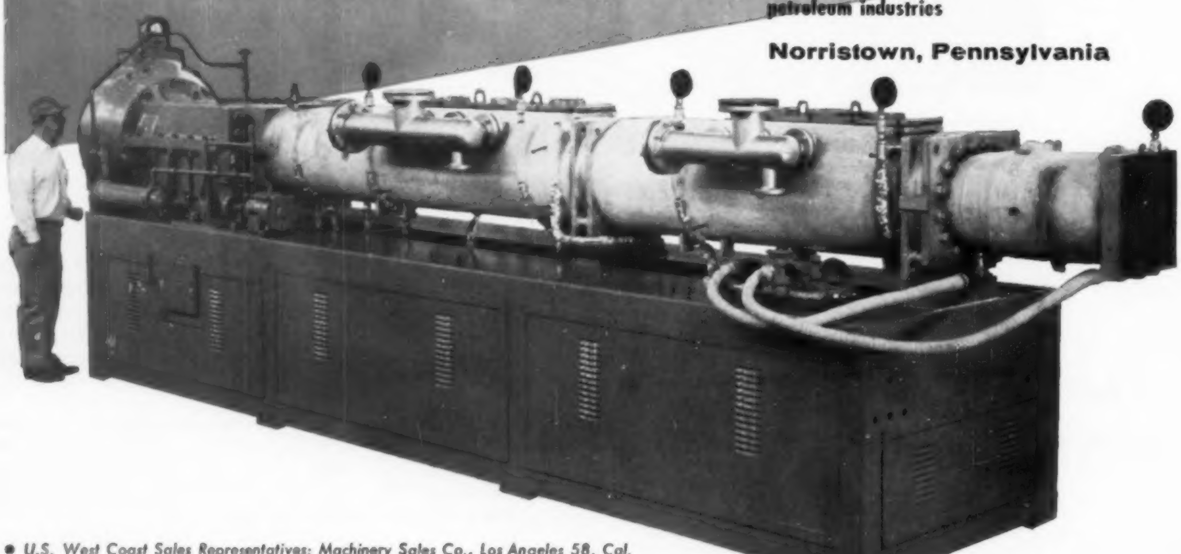

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PLASTICS ENGINEERING*

PROCESSING • FABRICATION • PRODUCT DESIGN • TOOL AND EQUIPMENT DESIGN

POLYPROPYLENE DINNERWARE, which is produced by Byrd Plastics Inc., Erie, Pa., was part of the field tests conducted for the Ferro spherical venturi plate's effectiveness in dry-coloring polypropylene. Even color dispersion was obtained on production run basis by using this new dispersion aid.

Dry coloring polypropylene

Newly designed spherical venturi gives excellent dispersions in difficult dry coloring problems

By Robert A. Charvat†

Basic economies for the injection molder have often resulted from dry-coloring plastics resins. Through savings in the purchase of resin, a reduction of inventory, and production flexibility, it usually brings lower cost and more efficient operation to both the custom and proprietary molder.

Normal dry-coloring methods work very well with polystyrenes and low-density polyethylene resin. However, with the newer resins—such as high-density polyethylene; high-melt-index, low-density polyethylene; and more recently, polypropylene—molders have experienced color dispersion problems. It was almost impossible to obtain satisfactory dispersions on a production basis with the dry coloring process.

Mechanical dispersion aids

Because of the advantages of dry coloring, some method of achieving uniform dispersion with these res-

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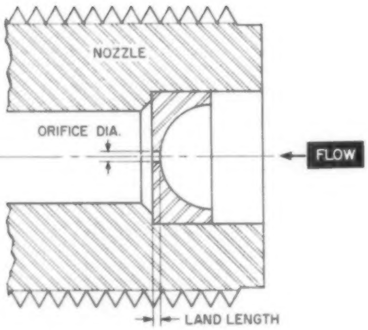
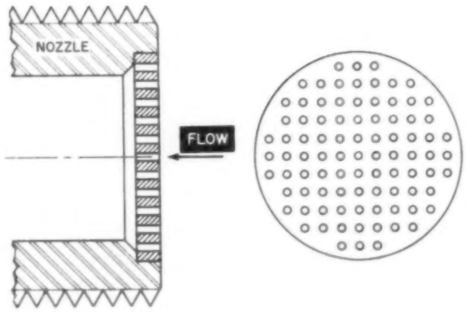


FERRO VENTURI PLATE

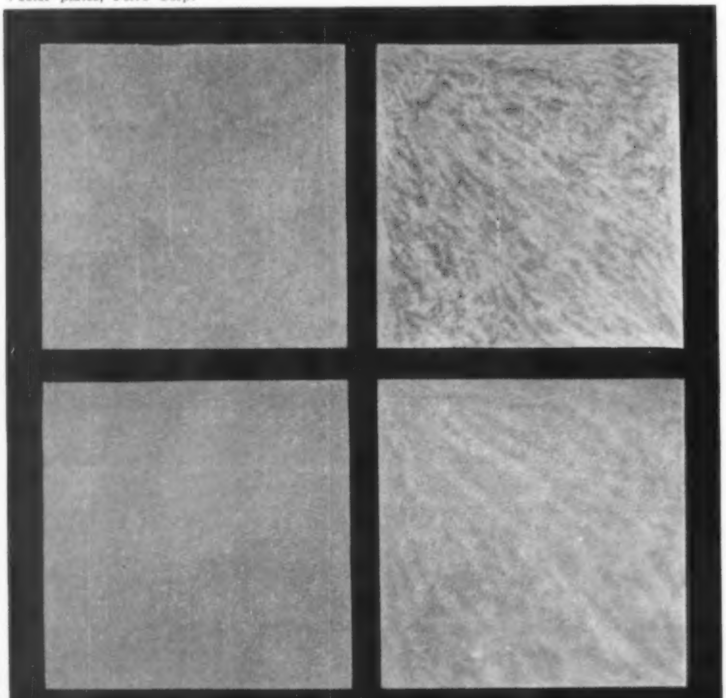
FIG. 1: Venturi plate, which is used for molding dry colored polyethylene.



MULTI-HOLE SCREEN

FIG. 2: Multi-hole screen is a thin, washer-shaped disk with multiple holes which, in effect, screens the resin. This type will prevent the passage of unplasticized pellets and offer little resistance to flow.

4-color plates, Ferro Corp.



LABORATORY TEST PANELS showing improvement in color dispersion through the use of new venturi plate. Parts on the left were run with dispersion plate, while parts on the right were run without dispersion plate. Pastel colors were the most difficult pigments to disperse of those tested.

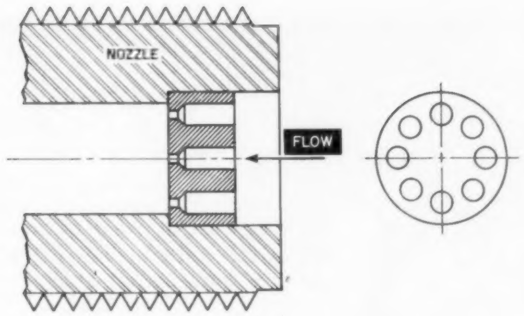
ins was required. Many inventive injection molders developed their own types of dispersion aids based on their trial and error experience. Suppliers also began experimenting with their own devices.

The most successful dispersion aids were mechanical mixing inserts mounted in the nozzles or cylinders of injection molding machines. Basically these inserts were designed to create a turbulence in the resin passing through the machine into the mold. Figures 1 through 6, above and on opposite page, illustrate the more popular types of inserts developed and used with various polyethylene resins. Many of these require no change in the nozzle or cylinder; others require extensive changes, such as counterboring, countersinking, and reaming.

Coloring polypropylene

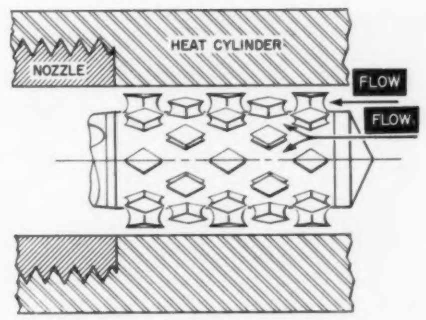
Polypropylene has many properties that make it an excellent injection molding material. At a relatively low cost, it offers desirable molding and end-product properties such as low shrinkage, physical strength, excellent chemical, heat, electrical, and abrasion resistance.

However, molders have learned that the dispersion aids they had been successfully using on other plastics were not as effective for coloring this new resin. Although it is similar in some aspects to nylon and high-density polyethylene, the melt viscosity of polypropylene drops very rapidly in the temperature range of 450 to 525° F. This gives it flow charac-



I. M. S. PLATE

FIG. 3: I.M.S. dispersion disk, which is a plate having from five to nine tapered holes. The upstream side of the hole has the largest diameter, tapering down to a small orifice on the downstream side. Many molders claim to obtain good dispersion with this type plate by reversing its position and placing the small diameter end of the hole on the upstream side.



SHAPED TORPEDO TYPE

FIG. 4: Shaped torpedo types, such as the pineapple torpedo and similar shapes, which cause a mixing action in the resin as it passes through the heating cylinder.

teristics similar to high-melt-index, low-density polyethylene.

In order to assist its customers with their color problems, Ferro Corp. initiated a program to develop a system for dispersing dry color in polypropylene. The result was the Ferro spherical venturi dispersion plate, shown in Fig. 7, p. 122.

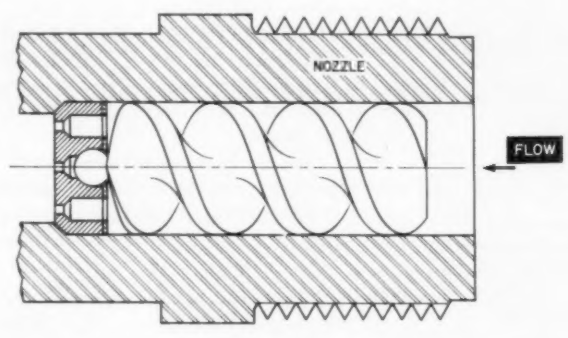
It was designed to be inserted in many molding machines without any alteration to the nozzle, heating cylinder, or any other part of the machine. It is positioned in the counterbore or taper at the rear of most nozzles. In many cases the spherical venturi plate can be inserted in the counter bore at the rear of a nylon-type nozzle, eliminating all modifications to nozzle or machine.

This dispersion aid is designed with a ½-in.-diam. internal spherical chamber with an inlet and outlet orifice located along a major axis of the sphere and coincident to the longitudinal center line of the nozzle itself. The ½-in. spherical size is important as it is in this area that a great deal of the mixing action, which disperses the pigment, takes place.

Effect of land length

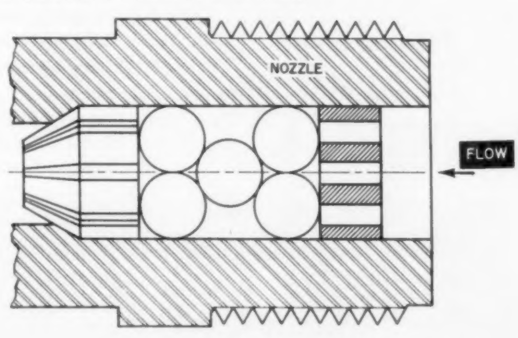
Tests with this plate and with the previously developed venturi plate for polyethylene, Fig. 1, demonstrated that land length of the dispersion plate orifice, has little, if any, effect on color dispersion. However, it is a major factor in pressure drop when using a device of this type. This pressure drop factor is very important as the shot size approaches the capacity of the molding machine. Therefore, land length should be kept as short as possible to minimize pressure losses when using the spherical venturi plate. A land length of 0.010 in. is usually practical and generally shows no excessive wear or collapse of metal around the orifice. Spherical venturi plates with a land length of 0.010 in. functioned properly during tests without structural failure. Figure 7 shows the practical limits as indicated by tests.

The orifice diameter is the most



NOZZLE PACK — SPIRAL

FIGS. 5 & 6: Nozzle pack type of dispersion aid, varies from inserting spirals, top (sometimes a wood bit) to ball bearings into nozzle to provide turbulent flow of resin.



NOZZLE BALL PACK

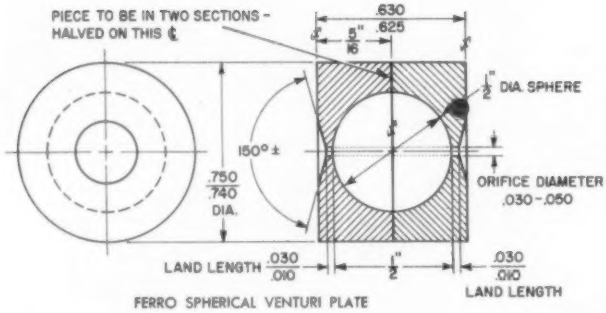


FIG. 7: Ferro spherical venturi plate is of simple design and manufacture. Critical dimensions are the ½-in. diameter of the spherical mixing chamber located in the center of the plate, the land length, and diameter of the inlet and outlet orifices.

critical dimension as far as dispersion is concerned. This diameter will usually vary between 0.030 and 0.050 in., depending on the particular molding job or machine. Some experimentation within these limits may be necessary to find the optimum orifice size. Factors such as the total cycle time desired, molding temperature and pressures to be used, complexity of the cavity, size of the shot, and capacity of the machine will determine the proper size for the best dispersion. For example, as the size of the shot increases and approaches machine capacity, the machine is required to fill a large cavity at a higher injection rate of flow through the spherical venturi. In this situation it is possible to enlarge the plate within the limits above and still develop the proper turbulence to gain the required dispersion. However, dispersion will probably drop off rapidly with an orifice diameter that is 0.050 in. or larger.

The Ferro spherical venturi dispersion plate can be manufactured and inserted without change in the nylon type nozzle of an 8-oz. Reed-Prentice injection molding machine (Fig. 8, below). Many lab tests and production runs were conducted with this dispersion plate installed in this type of molding machine.

Another dispersion plate with the same internal dimensions was manufactured to fit a 20-oz. HPM machine, the plate fitting into the tapered section at the rear of the nozzle (Fig. 9, below). This installation required a retaining ring to be placed behind the dispersion plate and between the mating surfaces of the nozzle and heating cylinder to prevent "suck back" from dislodging the plate and drawing it back into the heating cylinder. Extensive testing indicates that this washer in no way injures the mating surfaces of the nozzle and heating cylinder. Leakage did not prove to be a problem in this area. Generally, no damage or difficulty need be expected from this installation in the HPM or similar presses.

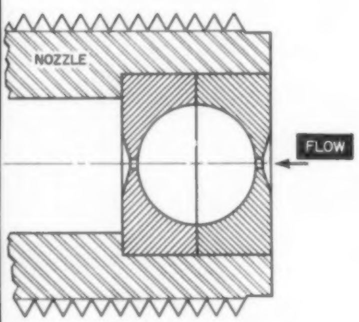
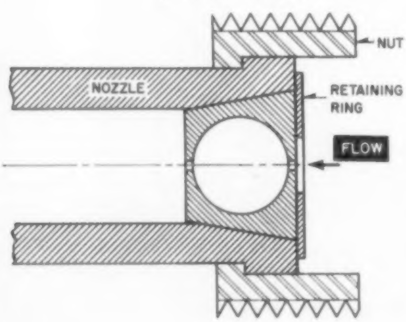


FIG. 8: Ferro spherical venturi plate installed in the nylon-type nozzle of an 8-oz. Reed-Prentice injection molding machine was fitted without altering nozzle.

FIG. 9: Ferro spherical venturi plate installed in nozzle of 20-oz. HPM injection molding machine. Body of plate was tapered to fit, and the retaining ring stops the possible suck-back.



Laboratory tests

Laboratory tests with polypropylene using the new spherical venturi plate were run on an 8 oz. Reed-Prentice injection molding machine. A 5-in. square panel weighing 2 oz. was molded. The temperature setting was 500° F. and injection pressure was 20,000 p.s.i. An orifice diameter of 0.030 in. and a land length of 0.030 in. was used for the spherical venturi

Table I: Laboratory test results with various color pigments[a]

Description	*Dispersion results*
Ferro red (F-13800)	
No plate	Poor
Spherical venturi plate, cold cut pellet	Good
Spherical venturi plate, hot cut pellet	Excellent
Ferro yellow (F-5512)	
No plate	Poor
Tapered hole disk, hot cut pellet	Poor to fair
Spherical venturi plate, cold cut pellet	Good
Spherical venturi plate, hot cut pellet	Excellent
Ferro pastel blue (F-7294) / Ferro pink (F-11556) / Ferro turquoise (V-2601)	
No plate	Poor
Spherical venturi plate, hot cut pellet	Excellent

[a]Part was 5 in. sq. panel; weight 2 oz.; molding on an 8-oz. Reed-Prentice injection molding machine.

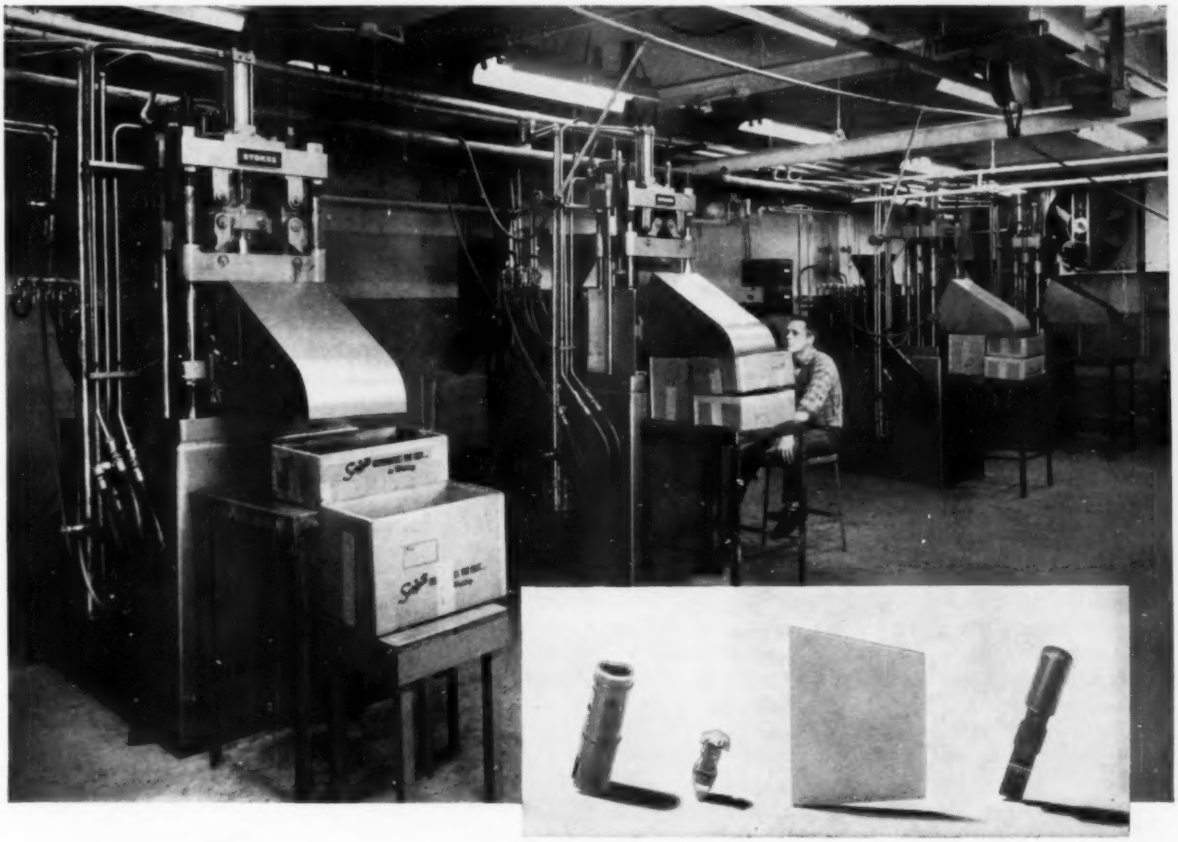


Table II: Field results on two molded trays[a]

Description	Molding pressure	Dispersion results
7½ oz. tray	*p.s.i.*	
No plate	7,300	Poor
Orig. venturi (.060 in. orifice)	9,820	Good
Spherical venturi (.060 in. orifice)	12,720	Excellent
7¼ oz. tray		
No plate	12,500	Poor
Orig. venturi (.060 in. orifice)	12,500	Good
Spherical venturi (.060 in. orifice)	12,500	Excellent

[a]One weighing 7½ oz. and the other 7¼ oz., both molded on a 12 oz. Reed-Prentice machine at a temperature of 450° F. Original Ferro Venturi Plate, Fig. 1, p. 120, tested against new spherical venturi plate, Fig. 7, p. 122, for dispersion results. Note pressures that were used in both instances.

plate. Tests were run using both cold cut and a hot cut pellet. A cold cut pellet results when the plastic material is cut and pelletized from cold strands. It is characterized by sharp edges due to the brittle nature of the cold fracture or cut. A hot cut pellet results when the plastic is pelletized while still hot, soft, and flowable. It is characterized by rounded edges formed as the hot pellet cools and contracts tending to form a sphere.

Tests were also run with and without the new plate installed. Five Ferro colors were used in the tests: red, yellow, pastel blue, pink, and turquoise.

During the molding of the yellow pigment, a control check was run using a tapered hole type dispersion plate instead of the spherical venturi plate.

Table I, p. 122, and the four-color photo on p. 120, show the test results that demonstrate the quality of dry coloring dispersion which can be achieved when molding polypropylene with the new spherical venturi plate.

Field tests

Laboratory testing will often indicate the basic soundness of a new idea, but the final test is in the molder's plant on his machine and product. And, generally, the molder is interested in more than just "it works." He is dependent on the device to do the job easily and economically. Field testing of the spherical venturi plate returned successful data to support the laboratory conclusions. Table II, above; Table III, right; and Table IV, below; detail several field results.

Field test results show conclusively that the new spherical venturi plate can be successfully used by injection molders to get dry colored polypropylene parts of excellent quality. The basic approach to a polypropylene molding job using the spherical venturi plate is to be aggressive. That is, do not hesitate to apply heat and pressure to maintain cycle speed and economical production.

Several advantages of the spherical venturi plate can be summarized as follows:

1. It provides an economic way to mold dry colored polypropylene.
2. It is of simple and inexpensive design, can be manufactured in the molder's shop, and is durable and trouble-free.
3. It makes possible quick purging from one color to another.

Table III: Effect of orifice diameter[a]

Description	Dispersion results
No plate	Poor
Spherical venturi (0.075-in. orifice)	Fair
Spherical venturi (0.063-in. orifice)	Fair
Spherical venturi (0.040-in. orifice)	Good
Spherical venturi (0.030-in. orifice)	Excellent

[a]A molded polypropylene drinking tumbler weighing 1½ oz. molded on an 8-oz. Reed-Prentice at a temperature of 475° F. and a molding pressure of 14,500 p.s.i. Orifice diameter varied.

A few tests run with other resins than polypropylene indicate that the plate will also give superior color dispersions in high-density PE and other resins.

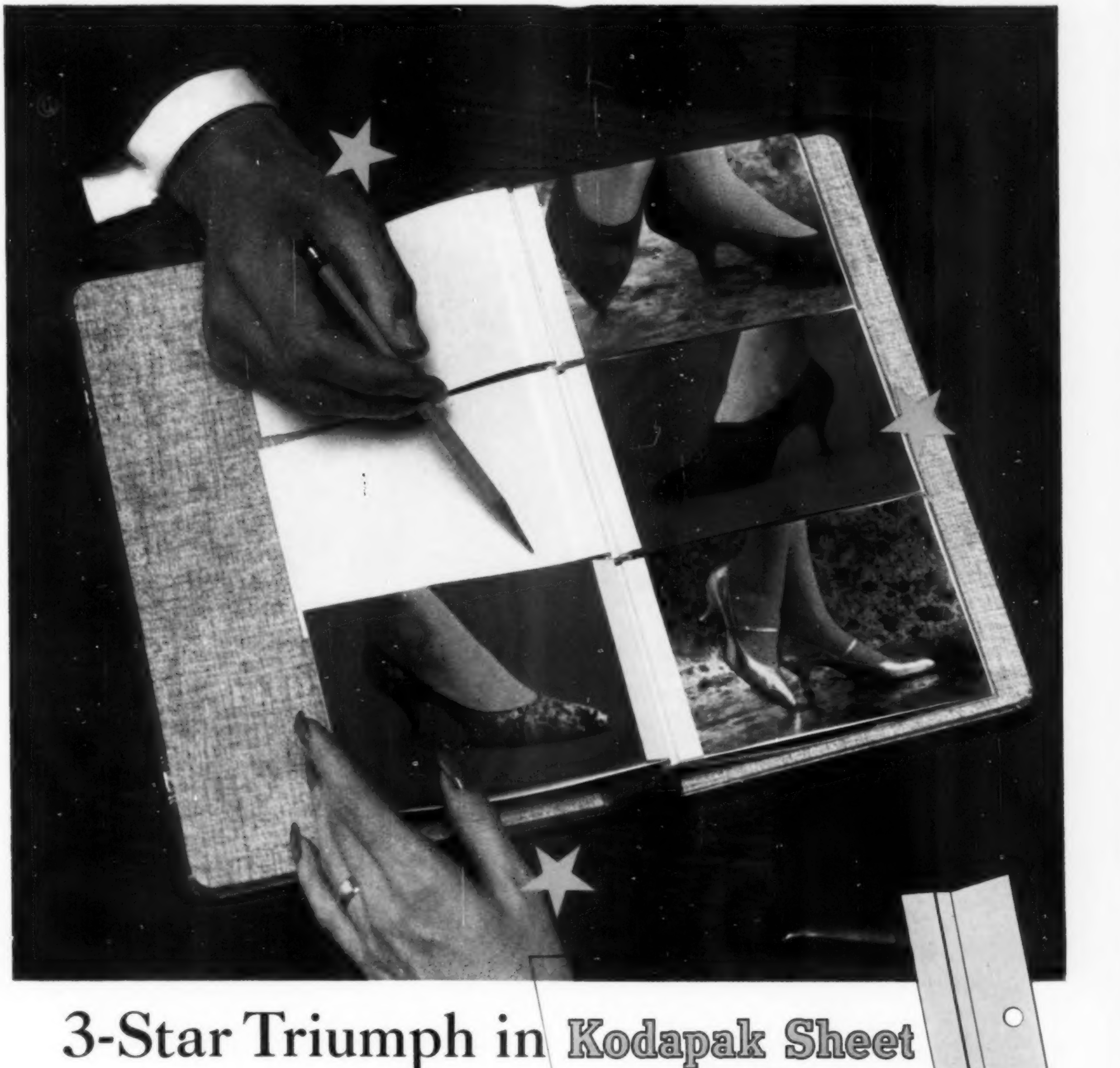
Acknowledgment

The assistance of the following companies for their cooperation in compiling this report is gratefully acknowledged: Hercules Powder Co. Inc.; W. R. Grace & Co.; Celanese Corp. of America; Lake Erie Plastics Co.; and Byrd Plastics Inc.—**End**

Table IV: Effects of various part designs on field tests using spherical venturi plate[a]

Description	Orifice diameter	Dispersion
	in.	
Dinner plate	0.050	Good to excellent
Bowl	0.050	Good to excellent
Cup	0.045	Good to excellent

[a]Dinner plate weighing 4 oz. molded on a 12 oz. Lester machine at a temperature of 500 to 570° F. and a molding pressure of 16,000 p.s.i. Bowl weighing 2¾ oz. molded on an 8 oz. Lester machine at a temperature of 500 to 570° F. at a pressure of 14,000 p.s.i. A coffee cup molded four at a time giving a total shot weight of 5 ounces. Cups were molded on an 8-oz. Lester at a temperature of 440 to 520° F. and a molding pressure of 10,000 p.s.i. All tests run with spherical venturi plate.



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Easy way to calculate injection molding set-up time

What can be done by the molder with basic polymer data and theory in estimating molding cycles

By R. L. Ballman* and Tevis Shusman*

The time required to remove sufficient heat from the molding so that it will not warp significantly when withdrawn from the die, called "set-up time," is often the most important factor in determining the overall cycle time for many molding jobs and is important in molding economics.

This article will discuss both qualitative and quantitative relationships between molding variables and set-up time. The quantitative treatment consists of applying unsteady-state heat-transfer theory to a simplified version of plastic cooling in the die cavity, and comparing theoretical with experimental set-up times. An effort has been made to facilitate practical application of this work. The chart on p. 131 is included so that set-up time can be computed from readily obtainable information on molding temperature and thickness of part.

Qualitatively, the molding and material variables influencing set-up are well-known. Set-up time decreases as polymer heat distortion temperature, polymer thermal conductivity, and gate size increase with increases in cylinder (stock) temperature, die temperature, cavity thickness, polymer density, and polymer specific heat.

How to determine set-up time

Quantitatively, minimum set-up time can be closely approximated from heat-transfer theory by making the following assumptions: 1) Die filling is isothermal or nearly so. 2) Temperature of the melt entering the die cavity is known or can be reasonably estimated from the press cylinder temperature. 3) Surface of die cavity remains at, or nearly at die-cooling-water temperature and is reasonably uniform. 4) Heat transfer at the mold surface is assumed to be infinite and the effect of separation of plastic and die surfaces due to shrinkage—even of thick sections preceded by small gates—can be ignored. 5) The molded part will be "set-up" when the innermost temperature of its thickest section has reached the heat distortion temperature of the polymer (1, 2).[1] 6) The ratio of surface to side-wall area is so high that cooling from the side-walls can be neglected. 7) All the terms of the Fourier series in the theoretical equation, except the first, can be neglected. 8) The effect of molecular orientation[2] and thermal stresses on warpage of moldings will be considered negligible. 9) The geometry of the molding will not exert a major influence on the temperature at which it will "freeze." Based on these simplifying assumptions, the equation for the "set-up" time, θ, becomes

$$\theta = -\frac{D^2}{2\pi\alpha}\ln\left[\frac{\pi}{4}\left(\frac{T_x - T_d}{T_c - T_d}\right)\right]$$

(Refs. 1 and 2)

where D is maximum cavity thickness, α is the polymer's thermal diffusivity, T_x is the polymer's heat distortion temperature, T_d is die temperature, and T_c is cylinder temperature. This equation has been plotted in Fig. 1, below, as a modified Gurney-Lurie Chart (3) to show the relationship between set-up time, cavity thickness, heat distortion, cylinder, and die temperatures **(To page 130)**

[1]Numbers in parentheses link to references on p. 194.
[2]In certain cases of very high orientation, this assumption may not hold.

*Plastics Division Research Dept., Monsanto Chemical Co., Springfield, Mass.

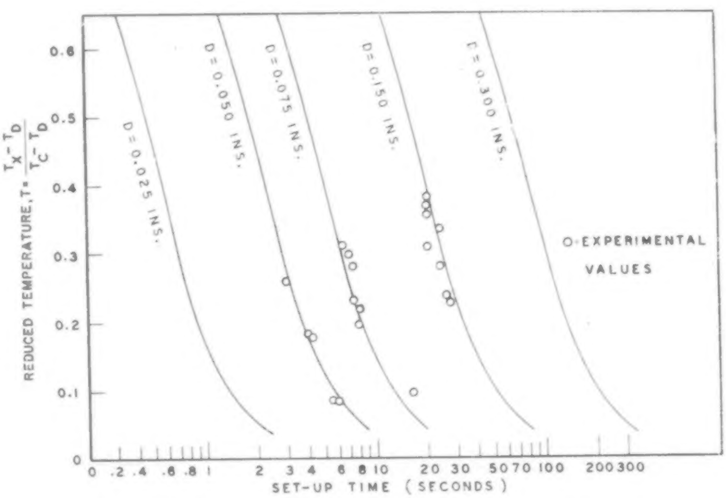

FIG 1: Comparison of the calculated theoretical set-up time with experimental observed values. Note the close agreement. Curves also show the relationship of set-up time to mold thickness and temperature variables. All data for an infinite slab of PS with uniform thickness.

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for GP styrene. The thermal diffusivity value for polystyrene has been calculated from specific heat data given in Bondy and Boyer (4) and from thermal conductivity data of McTaggart (5).

In order to test the validity of the assumptions given above and to evaluate the utility of the Fourier equation in estimating set-up time, several laboratory experiments were carried out on a commercial injection press. In these experiments, minimum set-up time was measured for shots of several thicknesses. The details of the molding procedure are given below and the results are compared with the calculated values that are shown in Fig. 1. Good agreement exists between these experiments and theory.

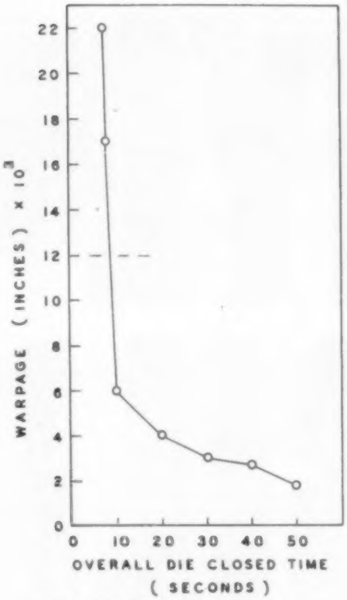


FIG. 2: Effect of total die-closed time on warpage of injection molded bars.

Experimental procedure

The following experiments were carried out on a 3-oz. injection press. A specially constructed die fitted with interchangeable parts, which allowed considerable latitude in simulating various molding conditions, was used. For this work, the die was assembled to mold a 12- by 1-in. bar gated at one end only. In three separate experiments, the cavity depth was varied to mold bars 0.050, 0.075, and 0.150 in. thick. Arbitrary molding conditions were selected and equilibrium was established by continuous operation. As each shot was removed from the die, the sprue and runner were carefully removed and the bar was placed on a flat surface and allowed to cool. The amount of warpage of the cold bar was then measured with a depth gage. The amount of warpage in terms of inches was used as a measure of the set-up time. A value of 0.012 in. of warpage was arbitrarily selected as an indication of the minimum over-all die-closed time necessary to give an acceptable molded bar. To determine the minimum set-up time, 1.5 sec. of dead and fill time was subtracted from over-all die-closed time.

A typical over-all die-closed time vs. warpage curve is shown in Fig. 2, left. In this graph the over-all die-closed time corresponding to 0.012 in. warpage is about 9 sceonds. When adjusted for dead and fill time of 1.5 sec., the true cooling time is estimated to be 7.5 sec. (assuming negligible cooling during fill).

By this technique minimum cooling or "set-up" times were obtained for a typical general-purpose polystyrene molding powder (with a heat distortion point of 186° F.) over several settings of cylinder and die temperatures for three die cavity thicknesses. Typical data are shown in Table I, below.

Significance

What is the practical value of this work? *First*, it appears that it can be used **(To page 194)**

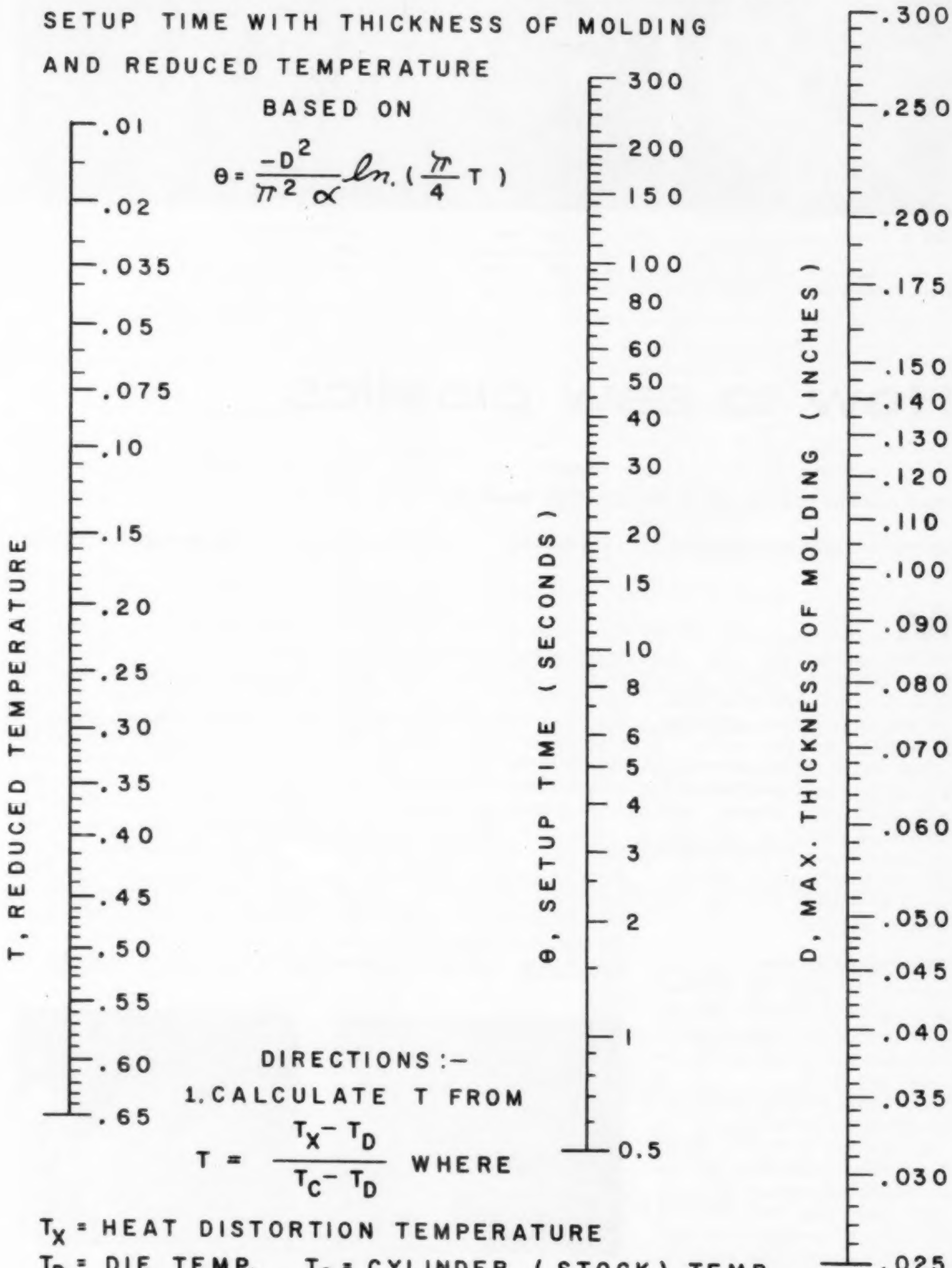
Table I: Experimental results with general-purpose polystyrene

Mold thickness D	*Die temp.* T_d	*Cylinder temp.* T_c	*Die-closed time* θ'	*Observed set-up time* θ	*Calculated set-up time* θ
mils	°*F.*	°*F.*	*sec.*	*sec.*	*sec.*
50	80	490	4.5	3	3.2 (From Fig. 1)
50	120	485	5.5	4	3.9
50	120	490	6	4.5	4.0
50	160	465	7	5.5	5.9
50	160	475	7.5	6	6.0
50	190	465	12	10.5	14.8
75	80	425	8	6.5	6.2
75	80	440	8.5	7	6.4
75	80	460	9	7.5	6.7
75	120	410	9	7.5	7.5
75	120	425	9.5	8	7.9
75	120	440	9.5	8	8.4
75	160	440	18	16.5	12.8
150	55	400	22	20.5	21.5
150	55	410	22	20.5	22.0
150	55	425	22	20.5	23.0
150	80	400	26	24.5	24.0
150	80	425	22	20.5	25.0
150	80	460	26	24.5	26.5
150	120	400	28	26.5	30.0
150	120	410	29	27.5	30.5

ALIGNMENT CHART FOR POLYSTYRENE, RELATING SETUP TIME WITH THICKNESS OF MOLDING AND REDUCED TEMPERATURE

BASED ON

$$\theta = \frac{-D^2}{\pi^2 \alpha} \ln . \left(\frac{\pi}{4} T \right)$$



DIRECTIONS :-

1. CALCULATE T FROM

$$T = \frac{T_X - T_D}{T_C - T_D} \quad \text{WHERE}$$

T_X = HEAT DISTORTION TEMPERATURE

T_D = DIE TEMP. T_C = CYLINDER (STOCK) TEMP.

2. PLACE STRAIGHTEDGE ON VALUE OF T AND VALUE OF D AND READ OFF SETUP TIME ON θ LINE.

FIG. 1: Three views of a circular saw having a "triple chip" type tooth design. Photo A (left) shows the radial slots in the blade to allow for thermal expansion. Photo B (center) is close-up of the "triple chip" carbide tips. Note that alternate teeth have a bevel on both sides of the tooth. Photo C (right) is a side view of the saw teeth showing "face rake."

How to saw plastics

Here are tips to help you in the selection, mounting, operation, and maintenance of circular saws

By George S. Mackrin*

Most fabricators are aware of their cutting labor costs per foot of cut, but few seem to know what their tool costs are in terms of maintenance, down time, and replacement costs per unit cut.

This article will discuss the factors to be considered in selecting and maintaining circular saws used to cut plastics and will serve to illustrate how the proper selection and maintenance of tools can result in a more profitable and efficient operation.

Selection of the saw

Don't be fooled by the low initial price of the tool—you get what you pay for. A cheap, poorly made saw will quickly nullify the initial cost saving.

All circular saws for plastic, except those for cutting heavily reinforced resins (see p. 197), should have carbide tips. However, the carbide-tipped saws are often not used since they cost about 15 times as much as an ordinary steel saw. This is really false economy, since the carbide tool has approximately 40 times the life of a regular steel tool. This means 40 fewer down times for saw changes, 40 fewer sharpening operations, and 40 fewer purchases. And, since the carbide saw cuts more easily, there is less operator fatigue and cuts are of better quality. The savings from increased production, reduced maintenance, and fewer rejects, are obvious.

Any reputable saw manufacturer can recommend the right blade design for a specific job if he is supplied with the proper information. He will need to know the type of machine on which the saw will be used, the speed at which the saw will operate, the type and thickness of the material to be cut, and the type of cut desired (rip, crosscut, miter, etc.). It is always wise to consult the blade manufacturer when production tooling is being planned, not after it is installed. It is at this time he can be more effective in recommending the most suitable equipment for the job.

Table I, p. 134, can be used for most plastics as a guide in selecting the proper ratio of the number of saw teeth to the diameter of a circular saw. From the chart it can

FIG. 2: Two views of another tooth design used on saws for cutting plastics. Compare these teeth to the teeth in Fig. 1. Note that alternate teeth in this saw have opposite bevels across the entire back of the tooth rather than the side bevels of the "triple chip" type. This type is better for cutting thin materials but blade life is very short.

*President of the Radial Cutter Mfg. Corp., Elizabeth, N. J.

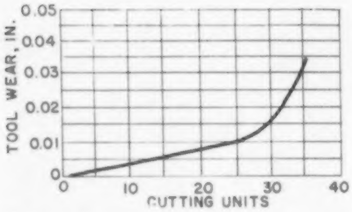


FIG. 3: Relationship for carbide tipped saws, between tool wear and use of the saw in terms of cutting units. Cutting units are not single cuts made by the saw. A unit is equal to a number of single cuts and will vary in magnitude, depending on the abuse a saw receives in cutting various materials. For most plastic materials each cutting unit shown above for carbide tipped saws is equivalent to the life of a steel saw. Because cutting units will vary with the cutting job, the significant point illustrated by the graph is that after a certain number of cutting units, the saw wear accelerates rapidly.

Table I: Guide for selection of carbide-tipped, circular saws for most plastic cutting jobs

Thickness of material *in.*		*Blade diam., in.*	*Blade teeth*	*Pitch*	*Kerf*[a]	*Remarks*
0.031	0.084	8	80	.313	C to AAA	Single sheet
		8	72	.384		
		10	96	.327		
		10	84	.373		
		12	120	.313		
		12	108	.349		
0.093	0.156	8	72	.348	C to AAA	Single sheet
			60	.417		or sheets
		10	84	.373		stacked
			72	.436		to
		12	96	.392		indicated
			84	.448		thickness
0.187	0.375	8	60	.418	C to AAA	Single
		10	72	.436		or
		12	84	.448		stacked sheets
7/16	3/4	8	48	.523	C to A	Single sheet
		10	60	.522		or
		12	72	.522		stacked
7/8	1 1/2	10	40	.784	C	Single
		12	60	.626		sheet
		14	60	.716		or
		14	72	.610		stacked

[a] Kerf classifications vary with the saw manufacturer. Classification shown are for Radialloy circular saws. Consult your supplier for equivalents.

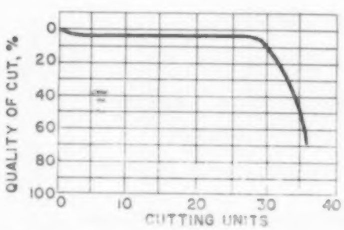


FIG. 4: Quality of cut versus cutting units showing decay in relative quality as wear on the tool increases. (See Fig. 3, above).

be seen that it is not practical to expect one blade to do a good job on a wide range of thicknesses.

The table also shows the class of kerf available for each saw blade. Kerf usually refers to the width of the cut. Table II, right, defines the width of the various classes of kerf mentioned in Table I. This classification is not standard and varies according to the manufacturer of the saw. (See note to Table I, above).

For quality of cut and for economy of material, a thin blade should be selected to cut as thin a kerf as is practical. The ability to cut a thin kerf is also dependent on 1) the accuracy of the machine, principally its spindle; 2) the accuracy of the feed; 3) the alignment of the fence; 4) length of cut; and 5) depth of cut.

The selection of the proper *face rake*, or the angle made by the tooth face with the radius of the blade, is also important. For plastics this should be 15° except for the cutting of heavily reinforced plastics. (See Fig. 1C, p. 132).

The tooth design should also be what is commonly known as "triple chip" (See Fig. 1). The design shown in Fig. 2, p. 132, is sometimes used and is claimed to give a better quality cut on very thin materials, but blade life is exceedingly short.

The teeth of the blade should be ground so that all do an equal amount of work. It is apparent that if some teeth protrude more than others, they will carry more of the load. Therefore, the side run out of the tips on a blade should never exceed the run out of the blade by more than 0.005 inch. Likewise, the bevels on the "triple chip" type of tooth should be accurately symmetrical or the blade may "walk" toward the heavily beveled side (Fig. 1).

Table II: Definition of kerf code used in Table I (See note to Table I)

Code	*Kerf thickness*
	in.
AAA	0.065
AA	0.084
A	0.094
B	0.110
C	0.135

The shank of the blade should be a high quality steel—a nickel chrome alloy is preferred because of its higher heat resistance. The shank should be flat and as smooth as possible to help prevent the collection of "gunk" from the plastic. A micro-finish of 8 to 10 is desirable. The bore of the blade should, of course, be concentric with the outside diameter.

All tools should be as small in diameter as is feasible. This increases strength and rigidity, reduces chattering, prolongs tool life, and lowers the tool cost.

Mounting the saw

The machine on which the saw is mounted should be in good condition, especially **(To page 139)**

Photomicrograph of a Polypropylene crystal

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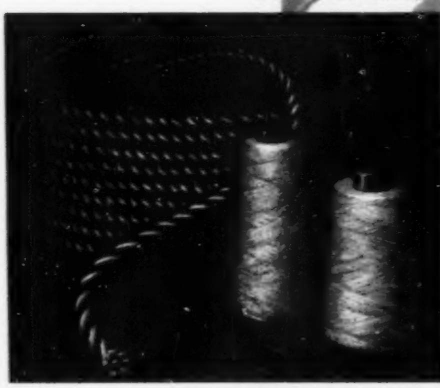

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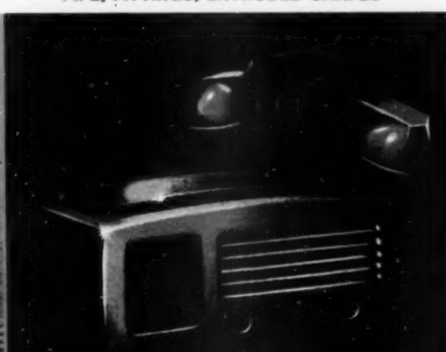

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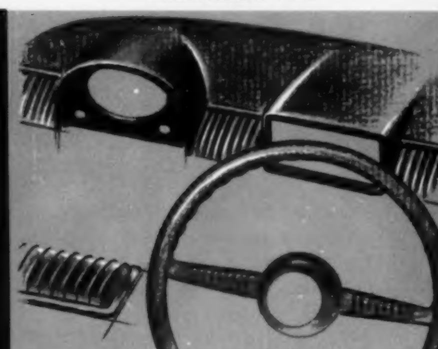

AUTOMOTIVE PARTS AND ACCESSORIES

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in regard to spindle, fence, tracks, and slides. It should have a variable-speed drive so that the spindle speed can be changed to the diameter blade used. However, many machines in use today have a single operating speed between 3,000 and 3,500 r.p.m. In this case a blade 8 to 16 in. in diameter should be used. Adequate power should be available to maintain proper speed of the blade while cutting. Cutting speed also depends on the material being cut; for longer blade life, the tougher the material, the slower should be the speed. Vibrations of the work piece caused by poor clamping or excessive overhang of the piece to be cut should also be avoided. If thin material is to be cut, it is advisable to replace the metal shoe through which the blade protrudes with a plastic shoe having a slot the width of the saw kerf. This will eliminate the vibration set up in the thin material due to overhanging a wide slot. The plate through which the blade protrudes must also be flush with the table and firmly seated. The fence on the machine should be checked to see that it will be parallel with the blade and the feed guide ought to be perpendicular to the blade.

In mounting the saw it is essential that the outside diameter be concentric with the spindle's axis of rotation and the blade perpendicular to the same axis. Wherever possible the blade should be set on the arbor between two flanges or stiffening collars of the largest practical diameter. These will serve to support the blade and avoid undue deflection of the circular saw. All faces and diameters in contact with the blade and spindle should be cleaned before assembling to avoid eccentricities due to trapped dirt particles. A light film of oil used on the flange will avoid freezing. Finally, when tightening the retaining nuts never use the blade teeth as a means of immobilizing the arbor or spindle.

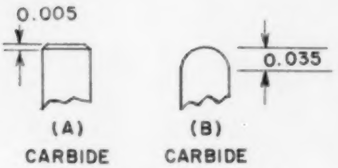


FIG. 5: Drawing A shows the amount of wear that can be tolerated before the carbide tips should be resharpened. Drawing B shows excessive dulling of a carbide tip. Since more material must be removed to square the tip, sharpening at this late stage radically reduces the life of the circular saw.

If after assembly a wobble in the blade is observed, release the retaining nut, change the relative position of the flanges and blade by rotating either 180°. If the side run-out does not disappear, be on the lookout for a defective part in the assembly.

In addition to the above, the following factors should also be kept in mind when mounting the blade: 1) a loose fit between the arbor and the blade will cause the saw to run eccentric and cut on only a portion of each revolution; 2) burrs, nicks, and scratches on stiffening collars, flanges, and spindles can cause a wobble in the blade and throw it out of true side run. To remove these, a flat oil stone of fine grit rather than emery cloth should be used; 3) poorly made, untrue stiffening flanges or retaining nuts will also cause the blade to deviate from true side run; 4) defective spindle bearings in the machine may result in radial play and vibration which will cause the blade to wear out faster and may even chip carbide teeth. End play of the spindle may also occur and will result in poorly finished cuts.

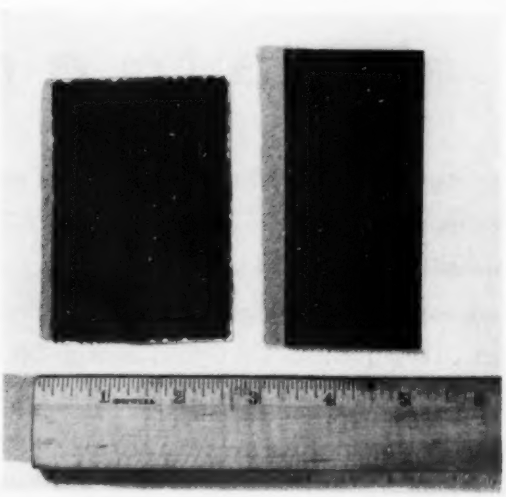


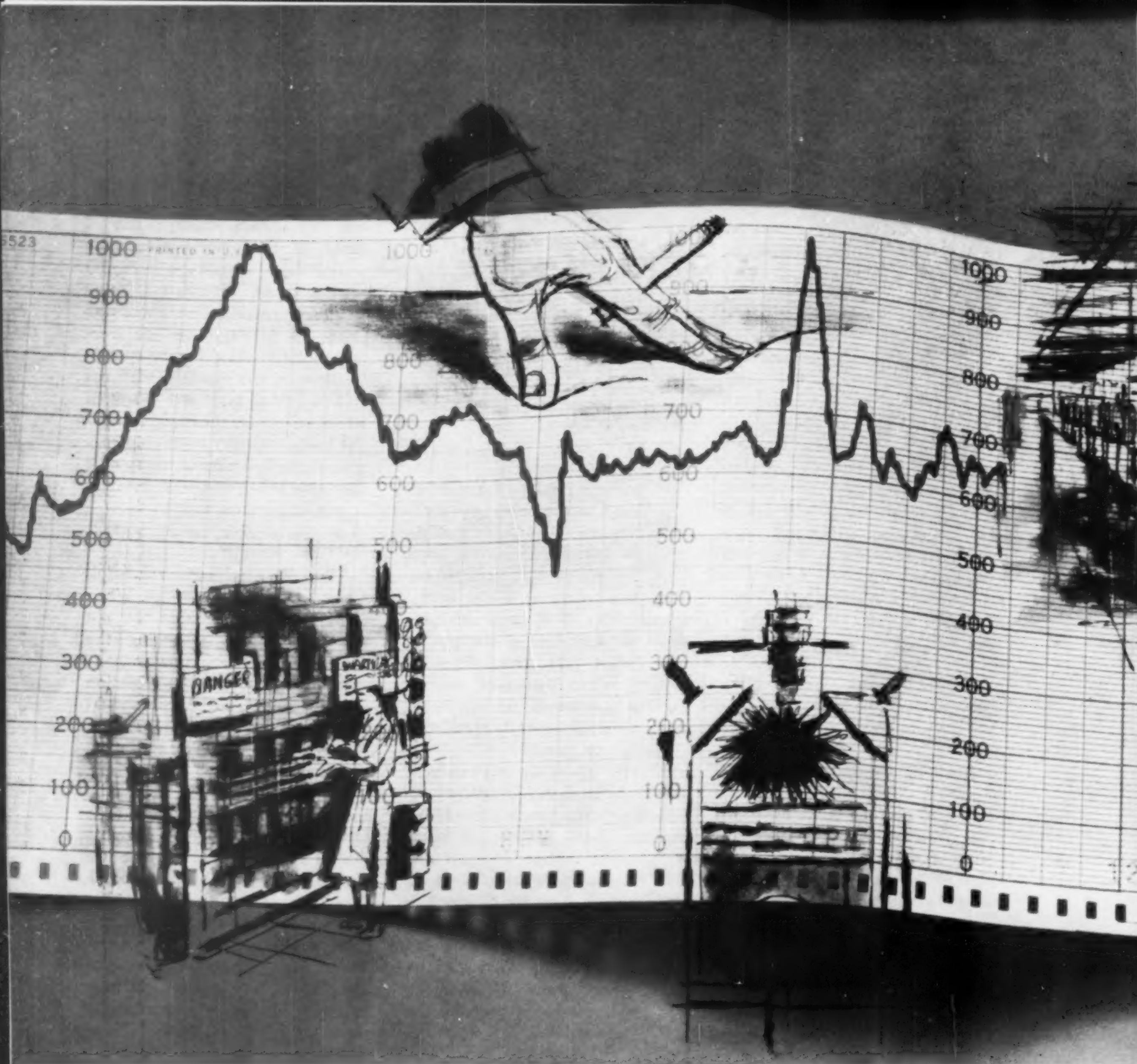
FIG. 6: Samples of laminates cut with dull tool (left) and properly sharpened tool (right). Note inferior quality, chipped edge of the piece that was cut with a dull saw.

Running the saw

Allow the machine to reach full speed before starting a cut. When using thin blades, start the cut slowly to avoid distorting the blade and use a hold down whenever possible to prevent vibration of the material. The blade should be adjusted so that ½ in. emerges over the material being cut at all times. When making an edge cut, start feeding slowly until the blade is fully engaged and then feed normally. Avoid stopping during a cut; letting the blade rub against the material. When necessary, clean the blade to avoid a buildup of material which will reduce clearances and cause overheating. A good way to clean the blade is to leave it overnight in a solution of 1 lb. of trisodium phosphate in 2 gal. of water. When cutting a coolant can, but need not, be used on the blade. Care should be taken not to damage carbide teeth with metallic objects when mounting or running the saw. If blades must be marked use acid etching or an electric pencil rather than stamping the figures on with a punch mark.

Maintenance

During the first cuts a tool wears very gradually in direct proportion to the number of cuts made. However after about 25 cutting units (not single cuts) on the tool using carbide saw, increases rapidly and cutting efficiency drops sharply (See Figs. 3 and 4, p. 134. Figure 5, above, shows two (To page 197)



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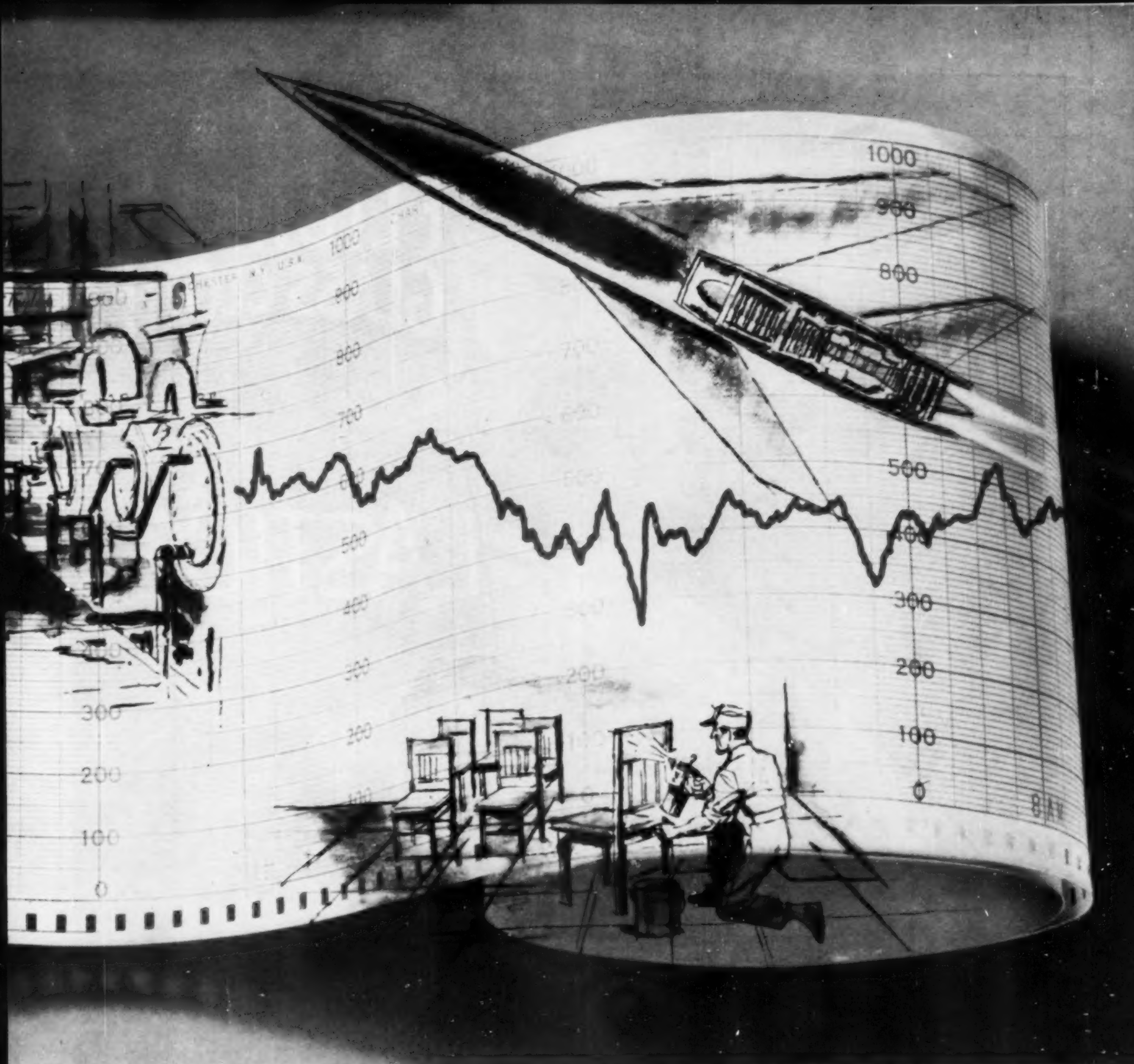

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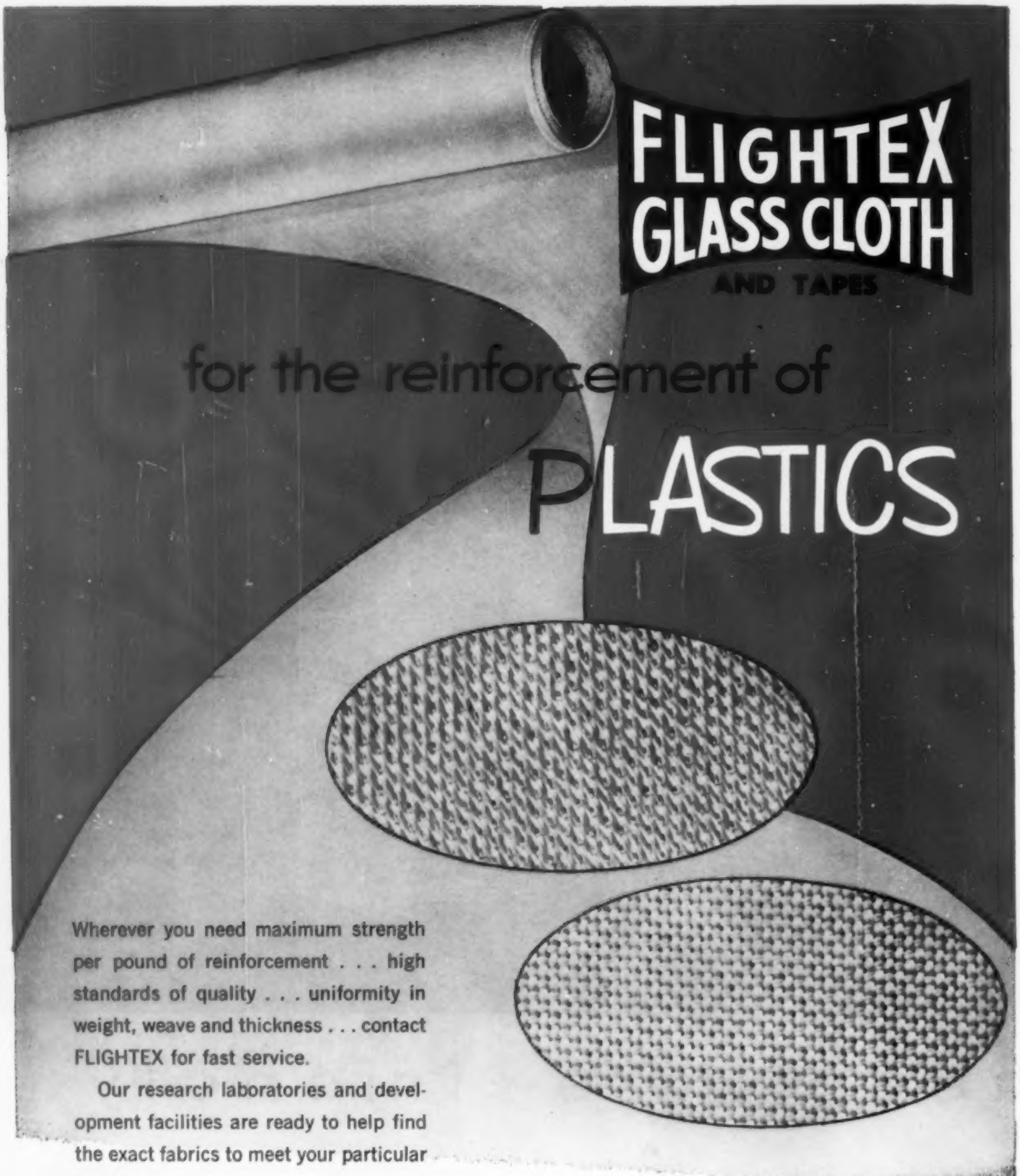

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PLASTICS* TECHNICAL SECTION

MATERIALS • PROPERTIES • TESTING METHODS AND INSTRUMENTATION • STANDARDS • CHEMISTRY

Reinforcing action of glass and organic fibers in epoxy laminates

Temperature-dependent and time-dependent mechanical behavior of an epoxy resin and its glass-cloth-reinforced and Dacron-cloth-reinforced laminates

By Charles D. Doyle†

Whereas glass contributes stiffness and strength to its laminates, Dacron contributes flexibility and toughness. The toughness contribution of Dacron is especially apparent in impact tests. Thermal expansion tests, dynamic mechanical tests versus temperature, and stress relaxation tests at elevated temperatures all show that Dacron contributes added stiffness to its laminates at temperatures above the softening temperature of the resin matrix. The stiffening effect of Dacron at elevated temperatures is small and short-lived, however, compared to that of glass.

The contrasting mechanical behavior of glass fibers and fibers of organic polymers affords an intriguing opportunity to gain further understanding about the reinforcing actions of their fabrics in plastics laminates. Glass, of course, imparts increased stiffness and strength to its composites, while the organic fibers confer toughness. The advantages of glass cloth and fabrics of organic fibers are sometimes combined by applying the tough organic cloths as overlays on rigid glass-resin cores. This technique is especially attractive in the case of water-resistant synthetic fibers, such as nylon, Orlon,[1] and Dacron,[1] among others(1-3).[2]

It was felt that useful and interesting information could be gleaned by comparing an unreinforced resin with its glass cloth and Dacron-cloth laminates. These systems were studied in terms of flexural and tensile tests, tensile impact tests, thermal expansion in two directions, dynamic modulus and damping versus temperature, and flexural stress relaxation at two temperatures.

Materials

An epoxy resin system was chosen for study because epoxies are commonly used in laminates and because nonreinforced epoxy specimens can be prepared easily. In all cases, the resin was prepared by mixing 28.5 parts by weight of methylene dianiline hardener (Dow Chemical Co.) with 100 parts of ERL-2774 epoxy resin (Union Carbide Plastics Co.). All specimens were cut randomly from ⅛-in. thick panels, which had been cured in the press for 2 hr. at 125° C., plus 2 hr. at 135° C., plus 4 hr. at 150° C. The Dacron cloth was identified as EXP-565 spun Dacron, plain weave, 31 by 33 thread count (Wellington-Sears Co.). The glass cloth was 181, Volan A finish, satin weave, 57 by 54 thread count (Hess-Goldsmith Co.). All panels were 12 by 12 in.; the glass laminate was made with 13 and the Dacron laminates with 7 plies. For the sake of brevity, the three types of material have been identified by code letters. These, and corresponding specific gravities, are listed in Table I, p. 145.

Flexural and tensile tests

Flexural and tensile tests were conducted according to ASTM D 790 and D 638. All tests were run in an Instron machine at 23° C., and 50% relative humidity, and at a cross-head speed of 0.05 in./min. The average findings, calculated on initial dimensions, are listed in Table II, p. 145, and plotted in Fig. 1, p. 144. The coefficients of variation of the 9-replicate flex-

*Reg. U. S. Pat. Off.
†Plastics Properties Chemist, General Engineering Laboratory, General Electric Co.
[1]Tradename of E. I. du Pont de Nemours & Co., Inc.
[2]Numbers in parentheses link to references at end of article, p. 200.

ural data are listed in parentheses beside the corresponding average values, except in the case of work-to-break, which was estimated from the areas under the average

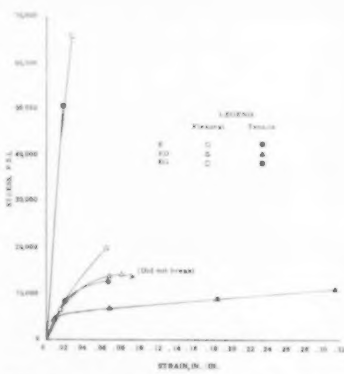

FIG. 1: Flexural and tensile tests at 23° C., 50% R.H., 0.05 in./min.

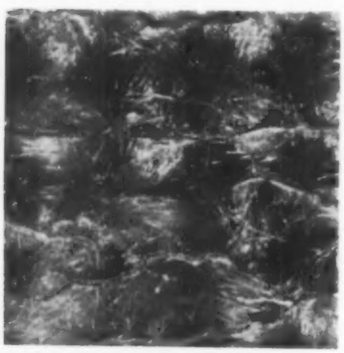

FIG. 2: Surface of a broken epoxy-Dacron (ED) specimen, photographed 20 power.

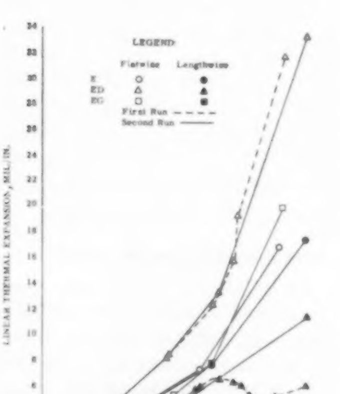

FIG. 3: Linear thermal expansion data.

stress-strain diagrams in Fig. 1. Since the tensile averages are based on only three replicates, their coefficients of variation were not computed.

In general, the data in Table II and the stress-strain diagrams in Fig. 1 simply demonstrate that glass fiber confers strength and stiffness, whereas the synthetic fiber confers toughness and ductility on their laminates. These are the expected observations in view of the properties of the reinforcing materials(4). It may be interesting to consider, however, why the proportional limit of the ED laminate is appreciably lower than that of the epoxy resin alone, even though the ultimate fiber strength of Dacron is some five times greater than the tensile strength of the epoxy, and the modulus of the ED laminate is slightly higher than that of the matrix resin. This seemingly paradoxical observation is due primarily to the fact that the components of a reinforced material do not fail simultaneously. Thus, it follows that the initial dimensions of a reinforced specimen provide an especially inaccurate measure of true cross-sectional area as soon as the first step in the failure sequence occurs.

In the early stages of tension tests on ED or EG laminates, the reinforcement and the matrix resin stretch together, being intimately bonded together. In the case of the glass laminate, it is the strong, relatively inextensible reinforcement that carries most of the load, whereas in the ED laminate, the reverse is true. Next, as the test load approaches the proportional limit range, tiny white spots appear on the surface of the specimen at the cross-over points in the weave. In both cases, such white spots indicate that the reinforcement fibers at the cross-over points are under high local stress. Sequential failure then occurs as the test load is further increased, but the failure mechanisms in EG and ED laminates are direct opposites.

In the glass laminate, it is the stressed glass fibers that begin to break at cross-over points, while the matrix resin, being about three times more extensible, remains essentially intact. In the case of the ED laminate, the situation is reversed, because the reinforcing fiber is some five times more extensible than is the matrix resin. When cross-over stress concentrations begin to appear in the weave, the adjacent resin cannot keep pace with the consequent local extension of the fibers, nor can the resin-fiber bonds be broken easily. As a result the resin yields and forms fissures at the cross-over points, as shown in the photomicrograph in Fig. 2, left. This, in turn, reduces the effective cross-section of the specimen so that the proportional limit, calculated on initial dimensions, is lower than that of the epoxy resin alone. The same is true of the EG laminate, but the effect is masked by the great strength of glass as compared with that of the epoxy resin.

The ultimate strength values in Table II also indicate that it is the resin structure that fails in the ED laminates, whereas the reinforcement fails in the EG samples. Judging from thread count and thread diameter, the effective cross-section of the ED laminate would be reduced to about one eighth of its initial area if complete failure of resin had occurred, leaving only the reinforcing cloth intact. The ultimate tensile strength of the ED laminate is about one seventh of the fiber strength of Dacron. This indicates that the effective cross-section at rupture actually was very nearly that of the reinforcement only. The EG laminate, on the other hand, broke at about one eighth of the tensile strength of glass fiber, although better than one third of the initial EG cross-section was glass. This suggests that a great deal of glass had broken at cross-overs before ultimate failure occurred. Of course, when weave cross-over points are eliminated from resin glass structures (i.e., fish-rod stock), ultimate strength is increased.

It is interesting to compare the relative proportional limits of EG and ED as measured in flexure and in tension. When a glass cloth laminate is loaded in flexure, the resin matrix is sheared between relatively inextensible layers of glass cloth. In a tension test, on the other hand, the glass is loaded

much more efficiently, so that the proportional limit of EG is much higher in tension than in flexure. In the case of the ED laminate, the difference between tensile and flexural proportional limits is even smaller than in the case of the nonreinforced resin, owing to the great extensibility of the Dacron reinforcement.

Variance of flexural data

The coefficients of variation of the flexural data (listed in parentheses in Table II) show a lower limit near 3%, excepting proportional limit data and data based on the proportional limit. The proportional limit, measured as the point where linearity of the load-deflection curve ends, is subject to large errors in judgement. Its limiting coefficient of variance is about 10 percent. The derived property, modulus of resiliency, is more erratic, since it is the product of two erratic values. There are three especially interesting error values in Table II. These are the coefficients of variation of the modulus of ED and of the proportional limit and ultimate extension of the E samples.

The data scatter for ED moduli is more than twice as broad as for EG and E moduli. Moreover, the modulus of ED is slightly higher than that of E, although the average modulus of Dacron fiber(4) is about one third to one half the modulus of the clear epoxy. The broader scatter of the ED modulus data suggests that the slightly higher modulus of ED laminate may be due to the geometrical arrangement of the cloth in the matrix, a characteristic which varies from sample to sample.

Table I: Materials tested in investigation

Type	*Epoxy*	*Epoxy-Dacron*	*Epoxy-glass*
Code	E	ED	EG
Sp. gr., 23°/23° C.	1.197	1.251	1.778

The proportional limit data for the clear epoxy are nearly twice as broadly scattered as those for the laminates. A ready explanation is that the now reinforced resin is more sensitive to flaws, bubbles, and surface defects than are reinforced laminates. The increased scatter however, does not carry over to the ultimate strength values. It appears, instead, in the ultimate elongation data. Furthermore, a plot of individual values of ultimate strain versus the corresponding proportional limit data shows that the lower the proportional limit, the greater the ultimate strain will be. In spite of their quite similar initial moduli, the epoxy resin specimens behaved as beams of widely varying stiffness as the proportional limit was approached during loading. These observations suggest that flaws are not responsible for the increased data scatter.

It has been suggested (5) that a borderline size effect, and/or a borderline degree-of-cure effect may be the culprit(s). The size effect arises from the fact that the amount of tensile strain on the tension surface of a flexural specimen at a given beam deflection depends on the thickness of the beam. The thicker the specimen, the more the tensile face must stretch. Attempting to stretch and draw in toward the neutral axis of the beam, the tensile side of a thick specimen ruptures. The tensile side of a sufficiently thin specimen does not rupture at the same deflection. The thinner sample, then, seems more ductile. At a certain critical thickness the case becomes a borderline one, so that some samples behave more flexibly than others. If the thickness is not in the critical range, the same effect might arise because at a given thickness and deflection undercured resin is more ductile than is stiffer, overcured resin. If the resin is cured to a state between these extremes, variable flexibility is encountered.

Tensile impact tests

Tensile impact tests were run at 23° C. and 50% relative humidity according to the method

Table II: Results of flexural and tensile tests[a]

Properties	*Epoxy resin (E)*	*Epoxy-Dacron laminate (ED)*	*Epoxy-glass laminate (ED)*
Flexural properties			
Modulus of elasticity, p.s.i.	479,000 (2.97%)	534,000 (7.12%)	3,400,000 (3.93%)
Proportional limit, p.s.i.	6,600 (15.3%)	4,370 (9.73%)	28,500 (9.93%)
Modulus of resiliency,[b] in.-lb./in.^{3}	46.7 (32.0%)	16.7 (14.5%)	120 (19.7%)
Ultimate stress, p.s.i.	19,800 (2.96%)	14,200[c] (3.12%)	66,200 (3.28%)
Ultimate strain, in./in.	0.065 (11.3%)	0.081[c] (3.12%)	0.026 (3.73%)
Work-to-break, in.-lb./in.^{3}	751	—	1,460
Tensile properties			
Young's modulus, p.s.i.	460,000	532,000	3,310,000
Proportional limit, p.s.i.	8,310	4,810	50,800
Modulus of resiliency,[b] in.-lb./in.^{3}	75.1	21.7	388
Ultimate stress, p.s.i.	12,600	11,100	50,800
Ultimate strain, in./in.	0.066	0.313	0.015
Work-to-break, in.-lb./in.^{3}	607	2,600	457

[a]The values in parentheses are the estimated deviation expressed as a percentage of the corresponding average value.
[b]Area under the linear part of the stress-strain diagram (considered a measure of toughness).
[c]Sample could not be broken in flexure. Value refers to maximum load sustained during the test.

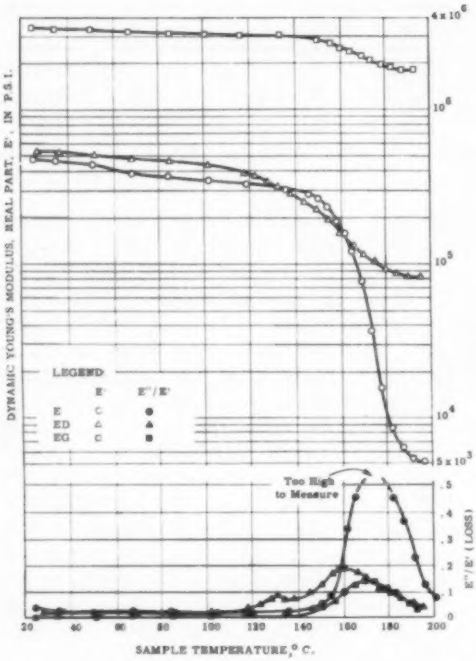

FIG. 4: Dynamic mechanical characteristics at equal loss peak frequencies compared with the temperature.

described by Bragaw (6). The apparatus resembles the familiar Izod machine, except that the specimen, of suitable shape for tensile testing, is clamped at one end to the base of the instrument. A free-floating cross-head is clamped to the other end of the specimen so that the cross-head face, which is struck by the hammer, is tangent to the curve of the hammer-swing at the bottom of the swing.

The EG specimens, being flat, could not be gripped strongly enough for breaking in the apparatus. However, five specimens each of ED and E were tested. The average findings are listed in Table III, p. 148, along with the corresponding coefficients of variation, shown in parentheses. For purposes of comparison, the tensile work-to-break data from Table II are also listed in Table III. Since there is some uncertainty about the effective gage length of tensile impact specimens, the data are listed in terms of work-to-break per unit cross-section rather than per unit of volume. The work-to-break data from Table II have been similarly converted by dividing volume-work-to-break by the effective gage length.

The data in Table III show that when the cross-head speed is increased from 0.05 in./min. to about 7000 in./min. the amount of work required to break both E and ED is greatly reduced. At the much higher testing speed, the materials have far less time to deform under stress. The epoxy matrix is more deleteriously affected by increased speed than is the Dacron fiber, by a ratio in the neighborhood of 3 to 1. This shows that the reinforcement in the ED samples contributes ductility to an appreciable extent even in regard to impact loading.

From a practical point of view, the high work-to-break found for ED in slow tensile testing may have little meaning, except perhaps as a factor of improved abrasion resistance. In the impact case, however, the benefit of Dacron reinforcement is directly apparent. Of course, smaller impacts would cause permanent damage in the ED laminate, but the material would not fly into pieces. The impact data also suggest that the ED laminate would be superior to the epoxy resin alone in resistance to cyclic fatigue.

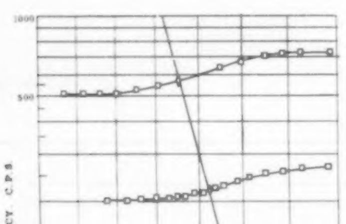

FIG. 5: Log of resonant frequency of epoxy-glass (EG) specimens versus the reciprocal absolute temperature.

Thermal expansion

Thermal expansion tests were conducted in a quartz combustion tube. The specimen, about 1 in. long, rested on the flat face of a quartz hemicylinder. A quartz rod, concentric with the combustion tube, transmitted the expansion of the specimen to a transducer whose rectified output was recorded on a chart. The rate of increase of the temperature near the specimen was automatically programmed for this study at 0.5° C. per minute.

The quartz transmission rod was lightly spring-loaded against the specimen, and slip-and-stick sliding friction was reduced by lubricating the inner surface of the combustion tube with powdered alumina. The observed coefficients of linear thermal expansion are listed in Table IV, p. 152, and the data are plotted in Fig. 3, p. 144. The plotted points in Fig. 3 indicate points of departure from linearity in the continuously plotted experimental charts.

The data in Table IV are based on the thermal expansion curves for specimens that were preheated to 220° C. During the first run, most of the internal stress of molding is relieved so that subsequent runs yield reproducible results. The stress-relieving effect is especially dramatic in the case of the ED laminate measured in the lengthwise direction, as shown in Fig. 3. After the 1-in.-

long specimen had cooled to room temperature following the first run, it was almost 6 mils shorter than initially. By way of contrast, the EG specimen was shortened by only about 0.5 mil. Here, again, the great extensibility of the Dacron fiber is apparent. Under molding pressure the ED laminate spread out some 12 times further than did the EG material, i.e. the EG laminate finally measured 144.1 sq. in. while the ED laminate would have measured 145.7 sq. in.

The curves in Fig. 3 show that the softening, or glass transition temperature range for the epoxy resin is in the neighborhood of 145° C. The addition of Dacron to the system introduces another bend in the curve at about 115° C. This is some 40° higher than the nearest glass transition temperature reported for polyethylene terephthalate (7). Mechanical damping data, as will be shown in the next section, also indicate that transitions in ED samples occur at temperatures that differ appreciably from the transition temperatures of the separate components of the laminate. These observations suggest that Dacron, unlike glass, interacts strongly with the epoxy resin. Interaction of the reinforcement and the matrix results in a well-integrated laminate wherein both the desirable and undesirable properties of the components are altered to a considerable degree.

In terms of linear thermal expansion, Dacron cloth behaves as a reinforcing material in the sense of constraining expansion of the resin in the lengthwise direction. In the flatwise direction, the reverse is probably true, i.e., the resin matrix constrains the expansion of the reinforcing material. In the lengthwise direction, this effect is overwhelmed by the tightening of the cloth weave at cross-over points.

Dynamic mechanical tests

The dynamic measurements to be described here were made by the vibrating reed technique (8, 9), wherein the sample, mounted as a cantilever beam, is forced to vibrate at a nondestructively low strain amplitude at its resonant frequency. The driving frequency is also detuned on either side of resonance in order to measure the frequencies at which the amplitude of the sample strain is half that at resonance. The dynamic mechanical characteristics of a material can then be calculated on the basis of the dimensions of the specimen, together with its resonant and half-amplitude frequencies. The dynamic mechanical characteristics of interest are E′, the real (or in-phase) part of the dynamic modulus, and E″/E′, the mechanical dissipation factor, whose magnitude depends on the amount of applied mechanical energy that is dissipated rather than elastically stored by the sample (8-10).

E′ and E″/E′ are interesting simply as measures of dynamic rigidity and damping capacity, but they are also interesting because their values undergo changes that are related to the thermal motions of molecules within the sample material. When the externally applied frequency is tuned to the frequency of such thermal motions, the applied energy couples with the internal energy of the sample so that E″/E′ increases to

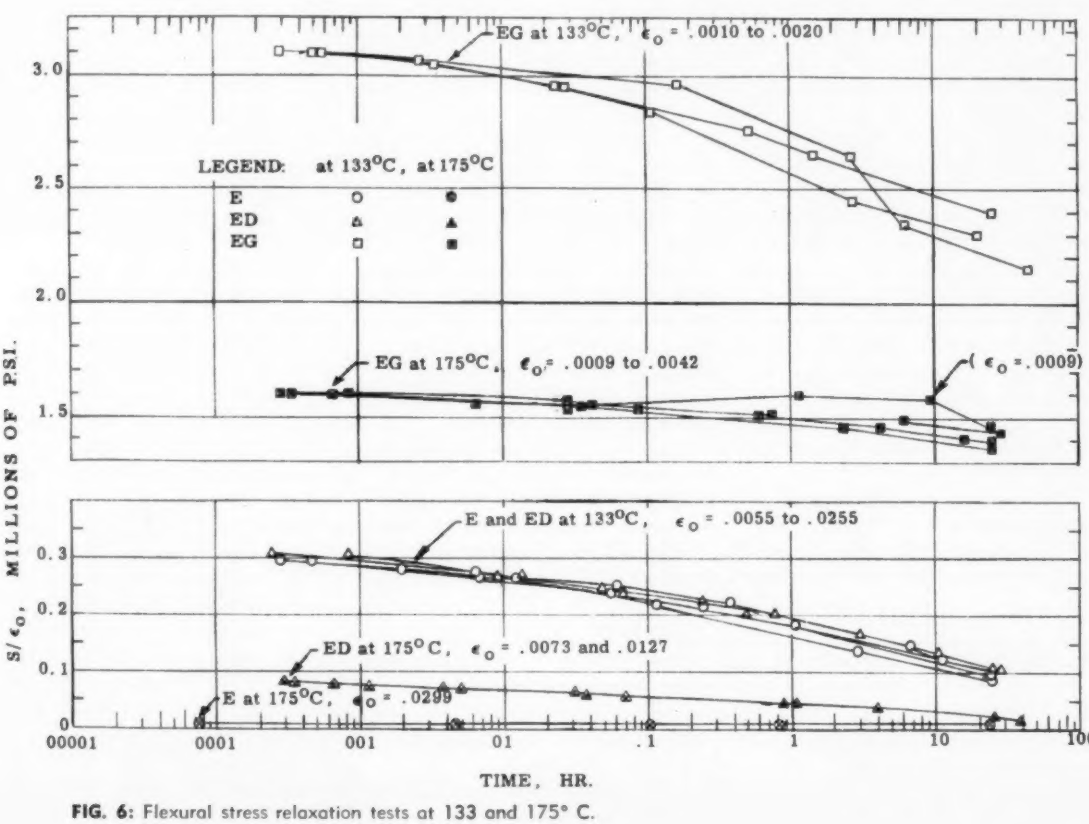

FIG. 6: Flexural stress relaxation tests at 133 and 175° C.

a maximum. Concomitantly, E′ passes through an inflection, since the dynamic rigidity of a sample depends on whether the period of the applied stress is long or short with respect to the relaxation times of load-bearing molecules. Such changes in E′ and E″/E′ can also be brought about by tuning the internal frequency to the applied frequency by changing the temperature of the sample. Ranges of applied frequency or temperature wherein such abrupt changes in E′ and E″/E′ occur are called "dispersion regions" (10).

In the present investigation, dispersion regions were located by changing the temperature of the sample. The vibrating reed tests were conducted in a modification of an apparatus which has been described previously (11,12). The modifications that were made in order to permit testing at temperatures up to 220° C., the experimental details of the method, and the expressions used in calculating E′ and E″/E′ are presented later in this paper.

The dynamic mechanical behavior of the E, ED, and EG samples is illustrated in Fig. 4, p. 146, for specimens which are comparable by reason of having nearly identical resonant frequencies (about 80 cy./sec.) in the middle of the dispersion region. It is interesting to note that the values of E′ at room temperature, as determined at low sonic frequencies, do not differ appreciably from the estimates of modulus of elasticity in bending, as determined from flexural tests on the Instron machine. This suggests that the moduli of the E, ED, and EG samples are not strongly dependent on strain rate in the range of strain rates up to about 300 in./min.

The dispersions of E′ as well as the corresponding peaks in the E″/E′ curves in Fig. 4, are related to thermal motions of a type that

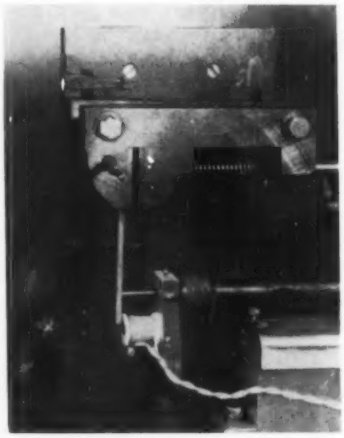

FIG. 7: Modified vibrating reed test assembly.

occur only at temperatures above the glass transition temperature of the epoxy resin (about 145° C.). The frequency of such thermal motion is related to temperature by the Arrhenius rate equation, as shown in Fig. 5, p. 146, for the case of three EG specimens having different resonant frequency ranges. The apparent activation energy calculated from the slope of the plot is about 59 kcal./mole. At the glass transition temperature the slope of Fig. 5 bends to a gentler slope corresponding to the lower activation energy for thermal motions at temperatures below the glass transition range. This is not shown in Fig. 5 because, unfortunately, the requisite low resonant frequencies are not attainable by the vibrating reed technique. Figure 5 illustrates the dependence of E′ on both temperature and frequency. As the applied frequency range is decreased, the drop in resonant frequency through the dispersion range decreases.

Since the dispersions in Fig. 4 are related to thermal motions at temperatures above the glass transition temperature of the epoxy resin, the magnitude of the decrease of E′ in the dispersion region is dependent, in part, on the degree of cross-linking of the resin matrix. In general, the lower the degree of cross-linking, the greater the change in E′ will be in a dispersion region that is related to softening of the resin (13-16). The drop in the E′ curve for the E sample is unusually steep, suggesting that the degree of cross-linking is quite low in this particular epoxy resin. The much shallower drop in the case of the EG sample supports the notion that reinforcements behave like cross-links in many respects.

Because the dispersions observed at low sonic frequencies occurred at temperatures very near the glass transition temperature, it is difficult to tell from Fig. 4 whether the epoxy resin changes to an appreciably rubbery material in its transition from the glassy state. Tests at higher frequencies, in which the dispersion is moved up the temperature scale, suggest that the polymer is only weakly rubbery. In the temperature range between the glass transition temperature and the temperature at which the dispersion begins, the plot of E′ continues to decline, whereas E′ would level off or increase with increasing temperature in the case of a more nearly ideal rubber. Stress relaxation tests also showed the epoxy resin to be only weakly rubbery above its glass transition temperature. It is quite extensible, but has little restoring force.

The E′ curve for the ED sample in Fig. 4 shows that Dacron contributes little additional stiffness to its laminate at temperatures below the softening range of the resin matrix. When the resin softens, however, the Dacron begins to act as a stiffening reinforcement, since its melting range is higher than the softening range of the epoxy resin. Unfortunately, as will be shown in the section on stress relaxation tests, this reinforcing action is quite temporary. There may be applications, nonetheless, in which short-time reinforcement is of value, for example, in a case where there is accidental overheating.

Comparison of the E″/E′ curves in Fig. 4 shows that, while the damping of the E (To page 152)

Table III: Work-to-break in tension

Work-to-break	*E*	*ED*
Tensile impact test, in.-lb./in.^{2}	6.42 (34.2%)	73.2 (23.6%)
Tensile test at 0.05 in./min. speed, in.-lb./in.^{2}	303	1300

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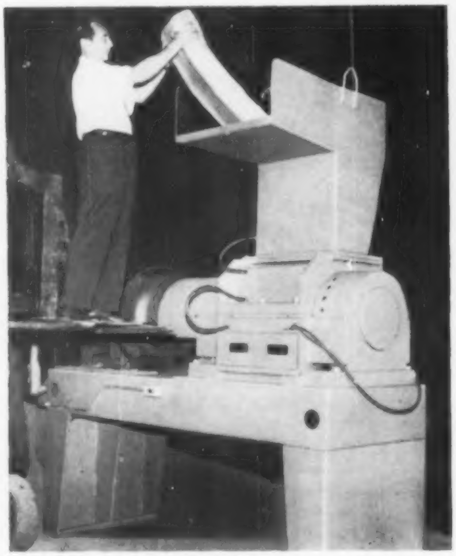

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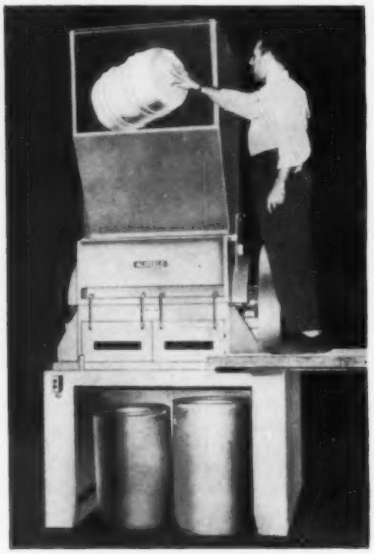

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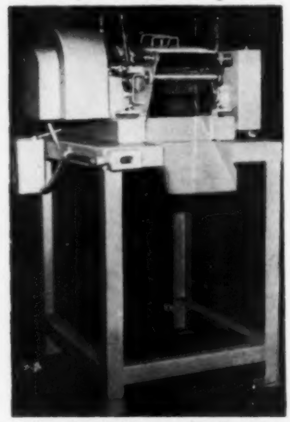

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Table IV: Coefficients of linear thermal expansion in micro-inches per inch per °C.

Temperature range	E Flatwise[a]	E Lengthwise	ED Flatwise[a]	ED Lengthwise	EG Flatwise[a]	EG Lengthwise
°C.						
24 to 120	63	61	90	42	55	15
120 to 160	100	74	120	75	110	15
160 to 220	150	130	290	70	220	4.7

[a]Based on 8 thicknesses of ⅛-in. thick material.

and EG samples peaked in the same frequency-temperature region, the loss peak for ED in the same frequency range occurred at a lower temperature. The curve for ED contains an additional peak at about 130° C. The E''/E' curve for ED, like the thermal expansion curve for this material, suggests that the Dacron reinforcement interacts strongly with the epoxy resin.

Flexural stress relaxation

Stress relaxation tests, like creep tests, provide a measure of the time-dependence of mechanical behavior. In a stress relaxation test the sample is quickly deformed to a given strain, then held in the strained position. During the holding period the restoring force decreases in many kinds of material. The internal processes that permit stress relaxation to occur are the same ones that permit a material to deform under constant load in a creep test, but stress relaxation data are easier to interpret than are creep data. This is true because any bonds that reform after rupture do so in the relaxed state in a stress relaxation test, whereas reformed bonds may subsequently rupture again in a creep test.

The E, ED, and EG samples were subjected to stress relaxation tests in three-point flexure in a forced-convection air oven. The specimens were kept at the test temperature for 16 hr. before the load was applied by allowing a massive weight to drop on a hydraulic jack to adjustable stops. Using this procedure, loading times were held below 2 seconds.

Because the supply of specimens was limited, the E, ED, and EG samples were tested at only two temperatures, 133° and 175° C. These temperatures were chosen because they lie below and above the glass transition temperature of the epoxy resin. The findings are presented in Fig. 6, p. 147, as plots of the apparent bonding modulus versus the log of time. The apparent bending modulus is the instantaneous maximum fiber stress, S, divided by the fixed flexural strain, ε_o. Through trial and error, most of the tests were conducted at fixed sample strains which were neither great enough to damage the specimen visibly nor small enough to render the test assembly sensitive to accidental shocks and vibration. Probably the worst case in Fig. 6 is that of EG at 175° C., $\varepsilon_o = 0.0009$. (The opposite extreme case, however, in which the sample of EG was damaged at 175° C., $\varepsilon_o = 0.0006$, is not shown in Fig. 6.)

For the sake of reduced confusion, specimen-to-specimen variation was averaged out of the data in the initial time periods so that related curves would start from a common apparent modulus level. The plotted points in Fig. 6 indicate the times at which the individual experimental data curves bent abruptly. In between plotted points, the data are linear with the log of time. It is seen that the locations of bends in the individual plots vary from specimen to specimen. Indeed, the average case might better be presented as a smooth curve.

In the time-scale of Fig. 6, there is little difference between the E and ED samples at temperatures below the glass transition temperature of the epoxy resin. This is in agreement with the corresponding plots of E' versus temperature in Fig. 6. At 133° C., Dacron contributes no additional stiffness to its laminate. Figure 6 also shows that the stiffness contribution of Dacron at temperatures above the glass transition temperature of the resin matrix is short-lived, relaxing in a few days at 175° C. As was noted earlier in this article, however, there may be practical uses for short-lived reinforcement.

The apparent modulus curves for the E and EG samples at 175° C. strikingly demonstrate the powerful reinforcing effect of glass cloth. The EG laminate is some 300 times stiffer than the resin matrix at 175° C., whereas the ratio at room temperature is about 7 to 1. The reinforcing effect of the glass is relatively long-lived. This is because even a weak matrix resin can serve as the adhesive for a strong structure if the bonded area is large compared to the glue line thickness.

Test method

The vibrating reed apparatus designed to permit testing at temperatures up to 220° C. is shown in Fig. 7, p. 148. The specimen is a cantilever beam ¼-in. wide, about ⅛-in. thick and from 2- to 5-in. long, depending on the resonant frequency desired. The clamped portion is 1 in. wide and is filleted down to the ¼-in. width on a ¾-in. radius, the fillet serving to enhance clamping efficiency. The specimen is suspended vertically rather than horizontally, since some materials soften appreciably on heating. A small strip of soft iron, weighing about 0.2 g., is wrapped tightly around the free end of the specimen so that alternating stress can be applied to the plastic material by means of an electromagnet[3]. The motion of the specimen is sensed by a capacitance-type pickup, shown in Fig. 7 as a small tube just above the driving coil. Since the potting resin formerly used to insulate the inner conductor of the pickup from the shield was unstable at elevated temperatures, an insulator was machined from lava.[4] The clamping, driving, and **(To page 198)**

[3]The magnet coil comprises 57 turns of 25-mil Teflon-coated wire laid up in 3 layers of 19 turns each.
[4]Grade A Natural Lava (American Lava Corp.), fired after machining.

Chlorine content of epoxy resins

How it affects the electrical and physical properties of the cured material

By W. J. Belanger* and S. A. Schulte*

The presence of residual chlorine in liquid epoxide resins is an apparently well recognized fact. Not as well known, however, is the effect that the residual chlorine content of epoxide resins has on the physical and electrical properties of the cured resins and the extent to which this effect is dependent on the type or chemical structure of the converter used to cure the resin. The magnitude of the residual chlorine content of liquid epoxide resins will normally vary from one source of supply to another and from one type of structure to another. In general, the aromatic epoxide resins such as those prepared from bisphenol and epichlorohydrin contain less than 1.0% chlorine, and the aliphatic epoxide resins such as those prepared from the various aliphatic polyols and epichlorohydrin contain higher than 1.0% chlorine.

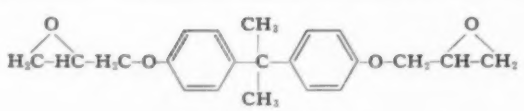
This investigation was undertaken to obtain a better understanding of how the residual chlorine content of epoxide resins affects the physical and electrical properties of the cured resins. Four liquid epoxide resins of the bisphenol-epichlorohydrin type were prepared with total chlorine contents ranging from 0.14 to 3.89%. Cured castings were prepared from each of these resins with both amine and anhydride then evaluated for a variety of curing agents. Each casting was then evaluated for a variety of physical and electrical properties.

Residual chlorine groups

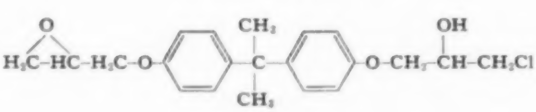
The pure diglycidyl ether of bisphenol (Formula 1), which is the principal component of most liquid epoxide resins, contains no residual chlorine. However, the commercially available liquid epoxide resins do contain small amounts of chlorine which is usually classified as either active, inactive, or total. The active chlorine, which is sometimes referred to as hydrolyzable chlorine, represents the percent chlorine in the resin present as 1, 2-chlorohydrin groups (Formula 2). The active chlorine is a result of incomplete dehydrohalogenation and is analyzed by reaction with alcoholic potassium hydroxide. The inactive chlorine in the epoxide resin is less reactive with nucleophilic reagents than the active chlorine. It is determined by subtracting the active chlorine content of the resin from the total chlorine content which be determined by combustion of the resin in a Parr oxygen bomb followed by a gravimetric analysis.

There are several possible mechanisms that can be used to explain the presence of the inactive chlorine. Two of the more important are as follows: 1) The reaction of the bisphenol anion with the central carbon atom of epichlorohydrin to yield a 1,3-chlorohydrin (Formula 3). The reaction of either the hydroxyl group or the corresponding alkoxide ion of a 1,2-chlorohydrin with additional epichlorohydrin to yield an isolated chloromethyl group in the polymer chain (Formula 4).

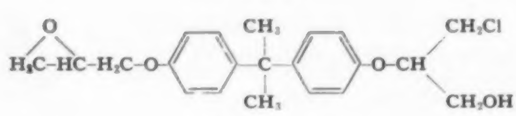
Although the inactive chlorine in the polymer chain is somewhat less reactive than the active chlorine, either type will react with primary, secondary, or tertiary amines at elevated temperatures to form the corresponding amine hydrochloride or quaternary ammonium chloride. Since each of these reaction products is ionic, it



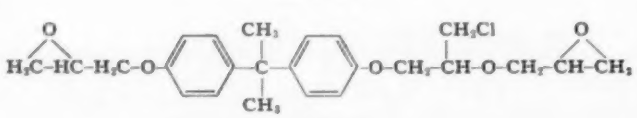
Formula 1



Formula 2



Formula 3



Formula 4

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Table I: Epoxide equivalent and chlorine content of the epoxy resins

Code designation of resin	A	B	C	D
Epoxide equivalent	173	190	200	244
Chlorine				
Active, %	0.03	0.04	1.31	3.76
Total, %	0.14	0.24	1.45	3.89

was initially suspected that the higher chlorine content resins would have more of an adverse effect on the electrical properties of the cured resins, and that this effect would be more pronounced with amine converters than with anhydride converters.

The liquid epoxide resins evaluated during the course of this work are listed in Table I, above. Resin B is a commercial sample of Epi-Rez 510 which is a typical liquid epoxide resin manufactured by the Jones-Dabney Co. Resin A was obtained by molecular distillation of Resin B. Resins C and D were prepared especially for this study by using lower concentrations of sodium hydroxide in a process similar to that used to prepare Epi-Rez 510. Cured castings were prepared from Resins A, B, C, and D with the following curing agents: 1) diaminodiphenyl sulfone; 2) methylene dianiline; 3) triethylenetetramine; and 4) methyl Nadic anhydride (tradename of National Aniline Division of Allied Chemical Corporation for methyl-bicyclo-(2.2.1)hept - 5 - ene - 2,3-dicarboxylic anhydride).

Diaminodiphenyl sulfone (DDS)

In preparing the cured castings from Resins A, B, C, and D with DDS a stoichiometric quantity (one equivalent of amino group per epoxide group) of this converter was used with each resin. The curing schedule employed was 1 hr. at 150° C. followed by a postcure of 3 hr. at 220° C. The physical and electrical properties of the cured castings from this system are summarized in Table II, right.

Of the properties measured the only physical property appreciably affected by the varying chlorine content resins is the heat distortion temperature (HDT). With the possible exception of Resin D the HDT values obtained with this series of resins are directly proportional to the degree of cross-linking in the cured resin. The HDT value of 110° C. of Resin D, the high chlorine content resin, is lower than one might predict, suggesting that some decomposition reaction may have occurred during the elevated temperature postcuring schedule. A decomposition mechanism induced by the amine hydrochloride present may also be the explanation for the slightly lower flexural strength and impact strength of the casting that was prepared from Resin D.

In an effort to determine the importance that the chlorine content of the resin has in reducing the HDT of the cured resin, a low chlorine content epoxide resin having the same epoxide equivalent as Resin D was prepared and cured with DDS. This epoxide resin was prepared by mixing 65.1 parts of Resin B (epoxide equiva-

Table II: Physical and electrical properties of four different

Converter	*Diaminodiphenyl sulfone*			
Epoxy resin	A	B	C	D
Amount of converter, parts/100 resin	35.8	32.6	31.0	25.4
Heat dist. temp. (D648-56, 264 p.s.i.) ° C.	210	194	168	110
Wt. Loss (7 days at 150° C.), %	1.35	1.34	1.26	1.40
Izod impact strength (D256-56), ft.-lb./in. of notch	0.44	0.37	0.41	0.29
Flexural strength (D790-49T), p.s.i.	17,104	17,314	19,102	13,940
Water absorption (D570-57T, 24 hr.), %	0.30	0.30	0.25	0.23
Volume resistivity (257-57T, 1 min., 500 v.)				
25° C., ohm-cm.	6.4×10^{15}	3.6×10^{15}	1.4×10^{15}	5.1×10^{15}
93° C., ohm-cm.	2.7×10^{14}	2.8×10^{14}	4.4×10^{13}	2.6×10^{13}
130° C., ohm-cm.	1.9×10^{13}	2.2×10^{13}	2.3×10^{12}	1.7×10^{11}
150° C., ohm-cm.	2.3×10^{12}	4.1×10^{12}	2.0×10^{11}	4.0×10^{9}
180° C., ohm-cm.	2.7×10^{11}	4.0×10^{11}	8.8×10^{9}	$<10^{7}$
200° C., ohm-cm.	4.0×10^{10}	4.5×10^{10}	$<10^{7}$	—
60° C. after 96 hr. at 60° C. and 95% R.H., ohm-cm.	1.2×10^{14}	2.6×10^{14}	8.0×10^{13}	1.4×10^{14}
Dissipation factor at 1000 cy./sec. (D150-54T)				
25° C.	0.0018	0.0016	0.0015	0.0010
93° C.	0.0010	0.0016	0.0012	0.0010
130° C.	0.0010	0.0010	0.0013	0.0058
150° C.	0.0024	0.0023	0.0051	0.0329
180° C.	0.0021	0.0026	0.0130	—
200° C.	0.0024	0.0024	0.0375	—
Dielectric constant at 1000 cy./sec. (D150-54T)				
25° C.	5.15	4.96	4.86	4.45
93° C.	5.50	5.20	5.08	4.63
130° C.	5.34	5.16	5.08	5.26
150° C.	5.20	4.84	4.93	7.12
180° C.	5.22	4.92	5.59	—
200° C.	5.47	5.09	6.68	—
Dielectric strength at 60° C. (D149-55T), v./mil	394	403	394	384

lent = 190; total chlorine content = 0.24%) with 34.9 parts of Epi-Rez 520-C (epoxide equivalent = 516; total chlorine content = 0.28%). This resin mixture was then cured with 25.4 p.h.r. of DDS using the same curing schedule employed with Resin D. The HDT of this casting was 155° C., indicating that the chlorine content was a very definite factor in reducing the HDT of Resin D.

The 24-hr. water absorption values obtained with this series of resins are independent of the chlorine content of the resin and directly proportional to the concentration of curing agent employed since the resins containing the smallest percentages of amine curing agent also exhibited the lowest water absorption values.

The effect of the varying chlorine content of the resins on the electrical properties of the cured castings is also quite apparent, particularly in regard to the elevated temperature measurements of dielectric constant, dissipation factor, and volume resistivity. For example, with Resin D there is a rapid loss in these electrical properties at some temperature between 150 and 180° C.; with Resin C the volume resistivity value at 200° C. was too low to measure on the Type H4 Tera-Ohmmeter. Resins A and B do not undergo any appreciable changes in either dissipation factor or dielectric constant over the temperature range measured, and both of these resins still have a fairly high volume resistivity at 200° C. The difference in electrical properties between Resins A and B at temperatures ranging from 25 to 200° C. is negligible. One additional point of interest with this series of resins is that at 25° C. there is essentially no difference in the electrical properties of the various chlorine content resins. Moreover, the chlorine content of the resin does not appear to have any effect on either the dielectric strength at 60° C. or the volume resistivity measured at 60° C. after 96 hr. exposure at 60° C. and 95% relative humidity.

Based on the properties listed in Table II it seems reasonable to conclude that the principal property affected by the varying chlorine content resins is the HDT, and that the decrease in

cured epoxy resins

Methylene dianiline				*Triethylenetetramine*				*Methyl Nadic anhydride*			
A	B	C	D	A	B	C	D	A	B	C	D
28.6	26.0	24.7	20.2	14.1	12.8	12.2	10.0	92.4	84.2	80.0	65.5
166	155	136	104	105	102	98	88	137	147	141	111
0.54	0.60	0.63	0.99	0.78	0.83	0.76	0.93	0.26	0.38	0.30	——
0.38	0.37	0.44	0.59	0.44	0.39	0.43	——	0.31	0.32	0.39	0.41
18,816	19,086	19,835	24,304	20,035	19,997	21,425	——	20,896	20,526	20,982	20,185
0.17	0.18	0.16	0.16	0.16	0.17	0.16	0.16	0.24	0.20	0.21	0.19
$2.2x10^{15}$	$1.3x10^{15}$	$1.7x10^{15}$	$1.8x10^{15}$	$1.8x10^{14}$	$6.0x10^{13}$	$5.4x10^{13}$	$2.8x10^{13}$	$3.8x10^{15}$	$6.3x10^{15}$	$4.1x10^{15}$	$>10^{16}$
$2.2x10^{14}$	$1.9x10^{14}$	$1.3x10^{14}$	$9.3x10^{13}$	$2.1x10^{13}$	$1.2x10^{13}$	$5.7x10^{11}$	$2.6x10^{10}$	$5.3x10^{14}$	$6.4x10^{14}$	$3.3x10^{14}$	$9.2x10^{13}$
$2.5x10^{13}$	$2.6x10^{13}$	$6.1x10^{12}$	$2.9x10^{11}$	$2.3x10^{11}$	$1.0x10^{11}$	$1.1x10^{10}$	$<10^{7}$	$6.8x10^{13}$	$9.3x10^{13}$	$2.1x10^{13}$	$5.8x10^{11}$
$9.7x10^{12}$	$7.7x10^{12}$	$4.7x10^{11}$	$2.5x10^{10}$	$1.2x10^{10}$	$6.7x10^{9}$	$<10^{7}$	——	$5.1x10^{12}$	$6.7x10^{12}$	$1.9x10^{12}$	$2.5x10^{10}$
$7.3x10^{11}$	$2.5x10^{11}$	$2.5x10^{10}$	$<10^{7}$	$<10^{7}$	$<10^{7}$	——	——	$1.8x10^{11}$	$1.7x10^{11}$	$3.6x10^{10}$	$<10^{7}$
$5.6x10^{10}$	$2.4x10^{10}$	$3.3x10^{9}$	——	——	——	——	——	$4.0x10^{10}$	$2.9x10^{10}$	$4.7x10^{9}$	——
$3.4x10^{14}$	$2.8x10^{14}$	$2.4x10^{14}$	$1.2x10^{14}$	$3.7x10^{13}$	$2.4x10^{13}$	$1.2x10^{13}$	$4.3x10^{11}$	$6.5x10^{14}$	$7.5x10^{14}$	$4.8x10^{14}$	$1.6x10^{14}$
0.0007	0.0004	0.0005	0.0009	0.0018	0.0017	0.0015	0.0022	0.0003	0.0004	0.0003	0.0004
0.0006	0.0003	0.0009	0.0005	0.0010	0.0032	0.0075	0.0084	0.0002	0.0003	0.0002	0.0005
0.0002	0.0003	0.0005	0.0029	0.0044	0.0083	0.2100	0.1000	0.0007	0.0011	0.0007	0.0020
0.0003	0.0004	0.0013	0.0026	0.0124	0.0214	——	——	0.0028	0.0015	0.0039	0.0240
0.0007	0.0014	0.0029	0.0160	0.0300	0.0370	——	——	0.0061	0.0060	0.0076	1.1370
0.0023	0.0027	0.0065	0.3130	——	——	——	——	0.0053	0.0048	0.0295	——
4.76	4.83	4.60	4.76	4.45	4.68	4.70	4.70	3.98	3.92	4.02	4.31
5.07	5.08	4.52	4.95	4.89	5.21	6.03	5.70	3.95	3.93	4.01	4.21
4.87	4.89	4.81	5.40	5.54	6.08	10.30	10.14	3.97	3.82	3.99	6.03
4.85	4.93	5.05	5.72	6.00	6.51	——	——	4.25	4.06	4.59	10.06
4.85	5.11	5.32	5.58	6.70	8.55	——	——	4.82	4.81	5.75	17.79
5.06	5.19	5.26	7.00	——	——	——	——	5.70	5.52	6.45	——
410	416	401	397	403	422	399	——	376	385	376	385

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CYMEL 592 (asbestos-filled) Additional distinctive properties: resistance to atmospheric extremes; high dielectric strength. Typical applications: connector plugs; terminal blocks; a/c, automotive and heavy duty industrial ignition parts. Specifications: MIL-M-14E MME; Federal L-M-181 Type 2; ASTM D704-55T Type 2, SP1 SPEC NO. 27025.

CYMEL 1077 (alpha cellulose-filled) Additional distinctive properties: Surface hardness, heat resistance, unlimited color range. Typical applications: appliance housings, shaver housings, business machine keys. Specifications: MIL-M-14E – Type CMG (in approved colors); Federal L-M-181 Type 1; ASTM D704-55T Type 1, SP1 SPEC NO. 30026.

CYMEL 1500 (wood flour-filled)–CYMEL 1502 (alpha cellulose-filled) Additional distinctive properties: Good insert retention. Typical applications: meter blocks, ignition parts, terminal strips. Specifications: Cymel 1500 (MIL-M-14E Type CMG, Federal L-M-181 Type 6, ASTM D704-55T Type 6); Cymel 1502 (MIL-M-14E Type CMG, Federal L-M-181 Type 7; ASTM D704-55T Type 7.

BEETLE® UREA (alpha-filled) Additional distinctive properties: Economy of fabrication, economy of material, myriad translucent and opaque colors. Typical applications: wiring devices, home circuit breakers, tube bases, appliance housings. Specifications: Federal L-P-406A, LC 726-1, ASTM D705-55, Grade 1 (Arc resistance limits are in process of revision by ASTM), SP1 SPEC NO. 27026.

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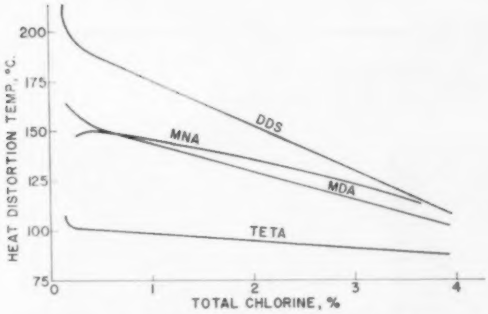


FIG. 1: Heat distortion temperature versus the chlorine content of epoxy resins that were cured with various converters as noted on curves.

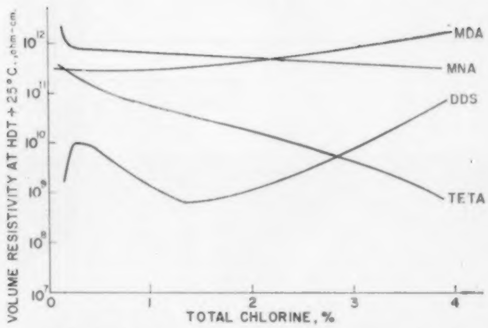


FIG. 2: Volume resistivity at 25° C. above heat distortion temperature versus chlorine content of epoxy resins cured with various converters.

electrical properties at elevated temperatures observed for the high chlorine content resins is a result of the lower HDT of these castings. If the HDT is the determining factor as far as electrical properties are concerned, this could also be the explanation for the fact that the electrical properties of Resins A and B in this system do not differ to any appreciable extent, for all of the electrical properties determined on these resins were measured at temperatures below their heat distortion temperatures.

Methylene dianiline (MDA)

The properties of Resins A, B, C, and D cured with stoichiometric quantities of MDA are listed in Table II. Each of these castings was cured for 1 hr. at 93° C., which was followed by a postcure of 2 hr. at 200° C.

The physical properties of the MDA cured resins followed essentially the same pattern as the DDS cured resins. The principal property affected by the varying chlorine content resins is the HDT. The difference in HDT between the distilled resin (Resin A) and Resin D is not nearly so large as that observed with DDS as a curing agent. With this series of resins, as with the diaminodiphenyl sulfone cured resins, there is a signficant difference in the HDT of Resins A and B.

The overall electrical properties are not as markedly affected by the varying chlorine content resins in this series as they are with the DDS cured resins. For example, with Resin C the HDT of the MDA cured resin is 22° C. lower that that of the DDS cured resin, but the elevated temperature electrical properties, as measured by the volume resistivity, dielectric constant, and dissipation factor, are appreciably better with the MDA cured resin. Actually the 200° C. electrical properties of Resin C are quite representative in comparison with the properties obtained from Resins A and B. Only a very marginal difference is detected between the electrical properties of the cured castings from Resins A and B. The room temperature electrical properties and the dielectric strength at 60° C., as well as the volume resistivity at 60° C. after 96 hr. exposure at 95% relative humidity, are not significantly affected by the varying chlorine content resins.

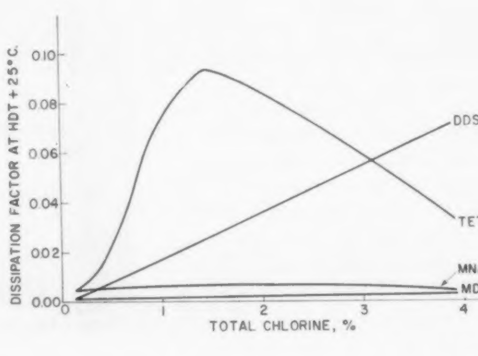
Triethylenetetramine (TETA)

The physical and electrical properties of Resins A, B, C, and D, cured with stoichiometric quantities of TETA are listed in Table II. The castings were prepared by curing the resins for 16 hr. at room temperature followed by a postcure of 2 hr. at 100° C. A considerable amount of difficulty was encountered in preparing a cured casting from Resin D and TETA. This was due to the higher viscosity of this resin (23,840 cp.) and what appeared to be a faster curing rate which presumably results from the higher hydroxyl content of this resin. Consequently, the test results with this casting are incomplete.

With this series of resins as with the aromatic amine cured resins, the HDT is the only physical property significantly affected by the different chlorine content resins. Although the difference between the HDT of Resin A and Resin D is considerably less than the value obtained with either of the aromatic amines, it is felt that this difference in HDT would have been larger if a higher temperature curing schedule had been employed. It is known that with Resin B and a higher temperature postcuring schedule it is possible to obtain HDT values at a temperature as high as 125° C.

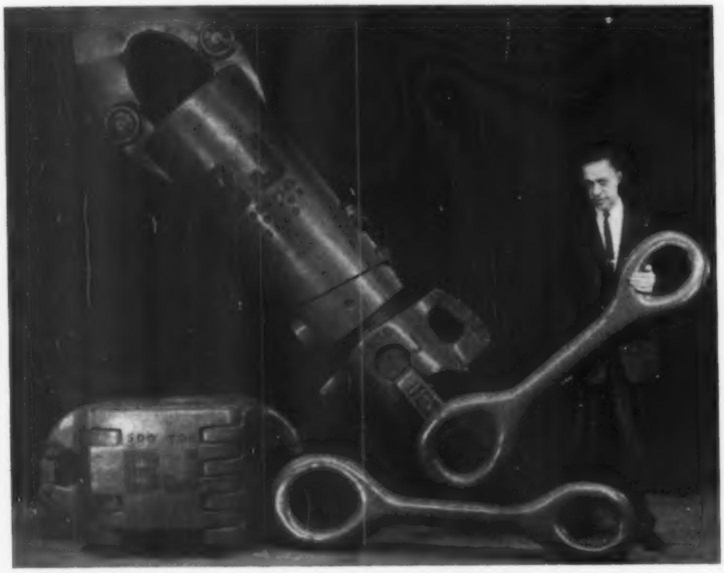
The effect of the different chlorine content resins on the elevated temperature electrical properties is more apparent with this series of resins **(To page 202)**

FIG. 3: Dissipation factor at 25° C. above HDT vs. chlorine content of epoxy resins that were cured with various converters.



NEW DEVELOPMENTS

Many minds at work on new ways to use plastics, new designs, and new product concepts offer ideas you can use.



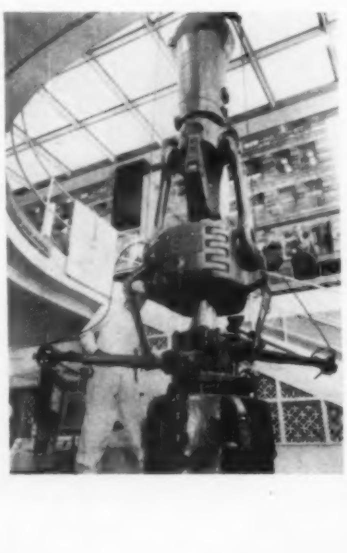
OIL DRILLING TOOL model (disassembled in above photo, in simulated installation below) is shaped from styrene foam at great weight savings.

Lightweight replica of drilling tool

Full-scale plastics replicas of some of the world's largest oil drilling tools, fabricated from styrene foam material, enable the manufacturer of the original tools, Byron Jackson Div., Borg-Warner Corp., to ship and display the items conveniently. They were recently exhibited at the International Petroleum Exposition, Tulsa, Okla., and will be used by the company in many exhibits.

Rather fantastic savings in weight were achieved by making the tools of light-weight cellular styrene material. Total weight of the exhibit tools shown in the accompanying illustrations is only 200 lb., as compared to 15,200 lb. for their cast iron counterparts. The original BJ hook (duplicated by the large unit in the background of top photo) weighs 10,000 lb., while the elevator (left, foreground, above) tips the scales at 4200 lb., or approximately the weight of a medium-priced motor car. The pair of giant links, in metal, weigh 1000 pounds.

The plastic tool reproductions, so realistic in appearance that it is virtually impossible to distinguish them from the cast iron originals, were produced by W. L. Stensgaard & Associates, Inc., Chicago, Ill. Working directly from detailed engineering drawings, Stensgaard first created actual scale drawings of the tools and then carved the various sections of Crystafoam (Styrofoam) supplied by Dow Chemical Co.



After being fully shaped "in the round," the foam styrene was covered with a layer of Sculpt-O-Fab, a nitro-cellulose-impregnated flannel fabric which is immersed in a solvent before application to the plastic material. Upon drying, it gives the displays a stone-like, damage- and fire-resistant surface. It is supplied by Ben Walters Industries, New York, N. Y.

To simulate the appearance of cast iron, a stippled paint was applied to the surface of the tools. Their bright red finish matches that used on the original BJ tools.

Surgical mesh

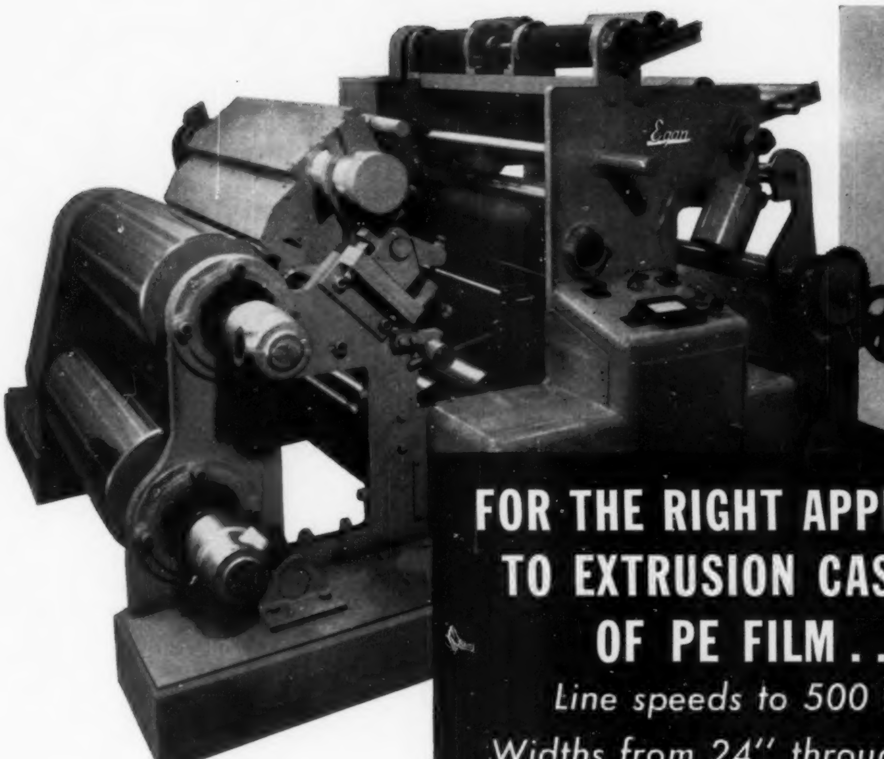
Surgical mesh of Marlex high-density polyethylene monofilament is being used to mend or reinforce areas that cannot be repaired with the patient's own tissue. The technique was developed by Dr. Francis C. Usher at Baylor University's College of Medicine, Houston, Texas, in cooperation with Phillips Chemical Co., Bartlesville, Okla.

Davol Rubber Co., Providence, R. I., supplies the woven mesh, which is easily penetrated by body tissue. Monofilament has the following advantages over a multifilament mesh: it will not harbor infections; there is no wick action; and it possesses considerably higher tensile strength—50,000 to 150,000 p.s.i.

Significant properties of the material that made it suitable for this application include chemical inertness in the presence of infection, resistance to acids, alkalies and most organic solvents, imperviousness to water, and the fact that it does not cause "foreign body reaction."

Although the mesh is sterilized by ethylene oxide before distribution to medical supply houses, it may be further sterilized by the user by boiling, since it has a 260° softening temperature.

(More on Page 162)



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(From page 160)

RP bodies for racers

Two manufacturers have announced new models of quarter midget racing cars (one-quarter the size of midget racers, designed for children from 6 to 16), using molded reinforced plastics bodies. The toughness, durability, and chemical resistance which have kept reinforced plastics on the horizon in the automotive field is a must for midget motoring.

The Crouse Co., Hatboro, Pa., molds racer bodies for Furlong M. A. P. Co., Furlong, Pa., using Union Carbide Corp.'s epoxy resin and fibrous glass supplied by Owens-Corning Fiberglas Corp. They have found that this material will stand up under blows that will collapse a metal body. Another rugged combination—polyester resin and fibrous glass—is used by Lunn Laminates Inc., Huntington Station, N. Y., in molding car parts for Larc-Douglas Co. Inc., Great Neck, N.Y. The polyester resin is supplied by the Plastics & Coal Chemicals Div. of Allied Chemical Corp., and the fibrous glass was obtained from Owens-Corning Fiberglas Corp.

Both companies use hand lay-up to mold the bodies. According to Crouse Co., a finished and trimmed body can be made in one hour if they utilize four molds simultaneously. The entire weight of the four epoxy parts is only 30 pounds. The polyester-fibrous glass body molded by Lunn Laminates consists of three parts, with a total weight of approximately 45 pounds.

The racers are easily assembled by using simple hand tools. For this reason, the racing cars are sold commercially both as completely assembled units and as do-it-yourself kits.

The Larc-Douglas racer is called the Offyette. Prices start at $498, in the do-it-yourself kit, and depend upon the number of accessories desired. The Furlong M. A. P. cars, called Vandy Specials, sell for $426 completely assembled. The do-it-yourself kit retails for $325.

RACING CAR BODIES molded at Lunn Laminates are stacked for shipment to Larc-Douglas for assembly. Photo above shows finished racer molded by Crouse Co. for Furlong M. A. P. Co.

Successor to Poppit bead

Flexible polyethylene Tarco Daisy Snaps recently introduced by Sidney A. Tarrson Co., Chicago, Ill. toy manufacturer, are so designed that each can be joined securely to the next piece, by forcing a molded-in stud through an opening molded into the center of the adjoining pieces.

Each set contains more than 200 snaps. By joining them together, children may create a belt, necklace, anklet, bracelet, hair band, and other designs limited only by their imagination. The snaps are packaged still on the sprue, making it easy to remove them as they are needed.

Salg Plastics, 2110 W. Grand Ave., Chicago, molds the snaps in a 98-cavity mold on an 8-oz. Reed-Prentice injection machine, using Tenite polyethylene.

Polystyrene spools

Clear polystyrene serving packages for glass yarn are more easily removed from machine spindles than the customary cardboard packages, according to the manufacturer, Johns-Manville Fiber Glass Inc., Toledo, Ohio. This ease of removal, of course, reduces down-time during spool change-over.

The end shields of the new packages are die marked on the edges. By snipping through these points with wire cutters, the operator can break the serving spool into two halves for quick removal. With cardboard packages, it is necessary to cut through the card- (To page 164)

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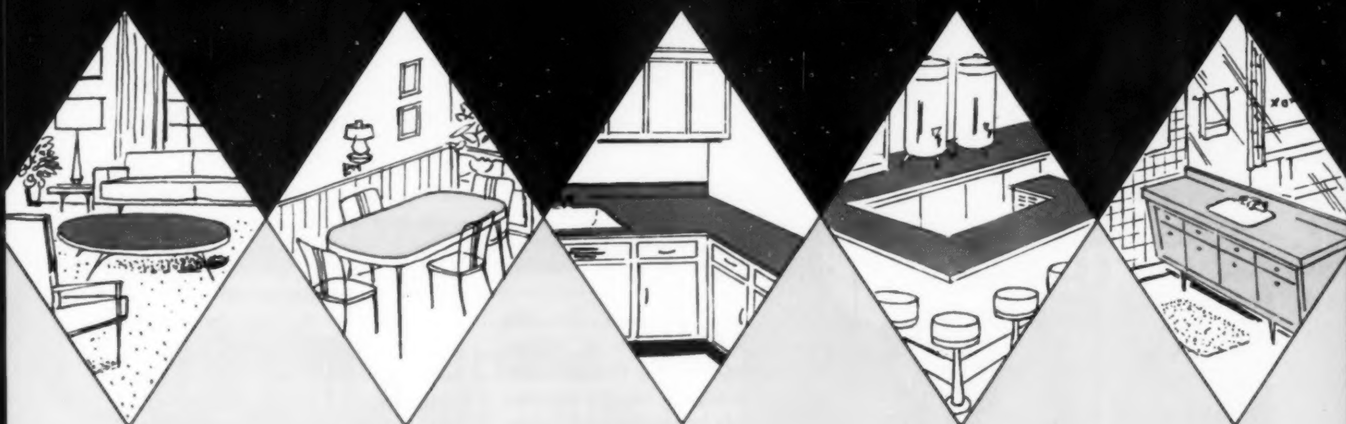

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board with a sharp knife and "peel" the package off the spindle.

The clear polystyrene packages also permit the operator to tell at a glance the amount of yarn left on the spool. With the cardboard units, the amount of yarn can only be determined when the operator stops the machine and removes the end shields.

OPERATOR uses wire cutters to snip die-marked point on edge of polystyrene serving package. Package breaks into two halves for easy removal from spindle.

Although developed for the serving of glass yarn at Johns-Manville operations, the packages are also available to all yarn and wire manufacturers. Two sizes are furnished, 1⅛- and 1⅝-in. I.D. Prices vary according to the different types of yarn used.

The packages are injection molded by Champion Molded Plastics Inc., Bryan, Ohio. Suppliers of polystyrene resins are Dow Chemical Co. and Foster Grant Co. Inc.

Cast vinyl stomach

A vinyl replica of the human stomach about ⅔ actual size and showing an ulcerous cavity by means of a cutaway section, is designed to aid physicians in explaining stomach ailments to patients. The models are distributed free to doctors by medical service representatives of J. B. Roerig & Co., which is the pharmaceutical division of Chas. Pfizer & Co. Inc., Brooklyn, N. Y.

Basically flesh-colored, the flexible stomachs also show veins, arteries, and aorta in red and blue colors, which are sprayed on through stencil mats.

The units are made by rotational casting at Bar-Lo Vinyl Products Co., New York, N. Y. Bronze molds were tried initially, but proved too heavy to do an economical job. Weighing about 30 lb. each, only two or three such molds could be placed in the fusing oven at one time; a greater number would be taxing both to workmen and oven. Aluminum molds were tested next, but trial shots were found to have surface air bubbles and blemishes. These conditions were traced to microscopic fissures in the metal, which, under oven heat, permitted air to permeate the liquid vinyl.

Ultimately, magnesium molds were tested and approved. They weigh 4½ lb. each, allowing eight molds to be inserted into the oven during one cycle, and they were free from fissures. Bar-Lo representatives estimate that the use of magnesium molds, as compared to bronze, resulted in a 20% cost saving to the firm.

In production, the eight molds are fastened to a circular plate and filled by air pressure at 1200 p.s.i. with a measured shot of liquid vinyl. A Lincoln multi-measure dispensing unit, made by Lincoln Lubricating Systems Inc., Long Island City, N. Y., is used. The Roto-Molder oven, manufactured by Mercury Molding Machinery Inc., Yonkers, N. Y., was adapted by Bar-Lo for greater heat retention by **(To page 167)**

VINYL stomach model has cut-away section showing ulcerous cavity (upper left); aids physicians in explaining ailment to patients.

the addition of extra insulation. In the oven, the circular plate is simultaneously rotated in a horizontal and vertical plane, and vinyl evenly coated against the interior mold walls. Shot weight is about 5½ ounces.

Geon, a product of B. F. Goodrich Chemical Co., is the basic vinyl resin in a formulation supplied by Dublon Inc., Newark, N. J. A circular stand, vacuum formed from styrene sheet by Dechar Corp., Brooklyn, N. Y., furnishes the platform on which the stomach is mounted by means of a wooden rod.

Big polyethylene shakers

Extra-large kitchen utility shakers, molded of low-density polyethylene, 3¼ in. high, with a 3-in. diameter, have molded-in handles; tops are friction fitted into place after molding.

The shaker bodies are molded by Westland Plastics Inc., Los Angeles, Calif., in a 4-cavity mold on a 12/16-oz. Reed-Prentice machine. Shot weight is 6¾ oz., and cycle time approximately 28 seconds. The tops are molded in a two-cavity mold on a 2-oz. H.P.M. machine, with an approximate 24-sec. cycle, and a shot weight of 1¾ ounces.

The shakers are supplied in several colors, and carry a suggested retail price of 49¢ each. Low-density Tenite polyethylene material is supplied by Eastman Chemical Products Inc.—**End**

POLYETHYLENE utility shaker has 3¼-in. depth, 3-in. diameter, is equipped with molded-in handle for simple and easy dispensing of dry ingredients.

LITERATURE

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Le Chlorure de Vinyle et ses Polymeres" (Vinyl Chloride and its Polymers) *by H. Gibello.*

Published in 1959 by Dunod-Editeur, 92, Rue Bonaparte, Paris (6°), France. 400 pages in French. Price: 3.800F. (ca. $7.80)

A comprehensive work on the polymers of vinyl chloride. The first chapter describes the synthesis of monomer and covers both its laboratory and industrial methods of preparation. Chapter 2 continues with a description of polymerization theory and its application to most of the known methods for polymerizing vinyl chloride (bulk, suspension, emulsion) and in copolymerizations, including discussion of industrial processes. Chapters on compounding of vinyl chloride give detailed property charts on plasticizers, stabilizers, solvents, pigments and other compounding ingredients. Also included are many formulations for specific uses in molding, extrusion, calendering, and vacuum forming. Final chapters describe many applications and are profusely referenced.—*G. R. S.*

Custom molding facilities. Describes a line of molded products available from the firm, including engineering and production facilities. Catalog 01.000.3. 4 pages. *The Richardson Co., 2750 Lake St., Melrose Park, Ill.*

Interior paints. Physical properties, compatibility with other paint ingredients, storage and handling data, etc., for Dylex Latex K-31, a styrene-butadiene copolymer latex. Technical Bulletin C-9-285. 32 pages. *Plastics Div., Koppers Co. Inc., 801 Koppers Bldg., Pittsburgh 19, Pa.*

Nylon stock shapes. Sizes available, typical applications, etc., for a line of Polypenco nylon and Nylatron GS stock shapes. 8 pages. *The Polymer Corp. of Pa., Reading, Pa.*

Protective coatings. Features, chemical resistance chart, uses, etc., for a line of Del protective coatings—vinyls, epoxies, acrylics, alkyds, etc. Bulletin 105. 16 pages. *David E. Long Corp., 220 E. 42nd St., New York 17, N. Y.*

Thermoplastic films. Gages, prices, etc., for a line of polyethylene, nylon, and polypropylene films. 6 pages. *Ludlow Plastics, Div. of Ludlow Papers Inc., Needham Heights 94, Mass.*

Thermocouples. Describes standard assemblies for general applications; specialized thermocouples and assemblies for laboratory and industrial applications; and a line of bare and insulated thermocouple wires, replacement elements, ceramic insulators, metal and ceramic protecting tubes, wells, terminal heads, and extension leadwires. Catalog EN-S2. 52 pages. *Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.*

Adjustable speed drives. Specifications, dimensions, gearmotor selection table, uses, etc., for a line of electric, adjustable speed drives for plastics and other industrial uses. Bulletin D-2507. *Reliance Electric & Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio.*

Low friction ring. Installation instructions, selector chart, specifications, etc., for a line of Teflon Glyd rings for hydraulic and pneumatic systems. Installed between the O-ring and moving surface, Glyd rings provide a chemically inert, nearly frictionless (0.04 coef.) contact, which eliminates torquing of the O-ring at initial actuation, and continues to keep running friction at a minimum. Bulletin S-200. 6 pages. *W. S. Shamban & Co., P. O. Box 1037, Culver City, Calif.*

Fibrous glass tubing. Electrical and thermal characteristics, oil resistance, flammability, compatibility, heat stability, sizes, colors, etc., for Hygrade Polytube, a class B polyester varnished fibrous glass tubing. 4 pages. *L. Frank Markel & Sons, Norristown, Pa.*

Measurement and control equipment. "New Gyro-Integrating Mass Flowmeter" describes theory, operation, and advantages of industrial flowmeter for measuring flow of fuels, industrial liquids, and gases directly in pounds, including ranges, specifications, dimensions, etc. Bulletin GEA-6925. 8 pages. "Complete Line of New General Electric Indicators and Controllers Offer Low-Cost Measurement and Control" describes d.-c. millivoltmeter and bridge-type controllers, temperature scanner systems, and saturable reactor control systems for indication and control of temperature and other variables. Bulletin GEZ-2898. 10 pages. *General Electric Co., Schenectady 5, N. Y.*

Thermoplastic resin. Properties, molding details, uses, etc., for Baker PL-11, an acrylic-type polymer for injection molding and extrusion. 3 pages. *J. T. Baker Chemical Co., Phillipsburg, N. J.*

Drives. Specifications, dimensions, minimum speeds, uses, etc., for a line of Allispede mechanical adjustable speed drives for industrial uses. Bulletin 3600. 6 pages. *The Louis Allis Co., Milwaukee 1, Wis.*

Unplasticized PVC. Physical properties, fabrication tips, equipment requirements, design and working aids, chemical resistance chart, corrosion resistance data, uses, etc., for Seilon rigid sheetings. 12 pages. *Plastics Div., Seiberling Rubber Co., Newcomerstown, Ohio.*

Export Product List. Descriptions, physical data, uses, and packaging information on 31 chemicals the company offers for export. 10 pages. *Hooker Chemical Corp., Box 344, Niagara Falls, N. Y.*

Micrometers. Features, specifications, uses, etc., for a line of motorized and hand operated micrometers for measuring thickness of foils, films, or thin sheets of plastics and other materials. 4 pages. *Testing Machines Inc., Mineola, N. Y.*

Acetal resin. "GRC Injection Molded Tiny Delrin Parts" gives typical commercial and potential uses of Delrin. Also included are properties of the material, e.g., resistance to organic chemicals, dimensional stability, abrasion resistance, chemical and electrical characteristics, etc. Bulletin 1001. 8 pages. *Gries Reproducer Corp., 125 Beechwood Ave., New Rochelle, N. Y.*

Plastics for Electronics . . . A Concise Compendium. Describes the company's line of dielectric materials, including casting resins, foams, absorbers, adhesives, impregnants, coatings, ceramics, and reflectors. Chart gives physical **(To page 171)**

and electrical properties, features, and major uses. 10 pages. *Emerson & Cuming Inc., Canton, Mass.*

Phthalate esters. "Ditridecyl and Didecyl Phthalates in High Temperature Vinyl Insulation" gives technical data on these esters, which are used for wire and cable extrusions, among other applications. Technical Bulletin 20. 9 pages. *Enjay Co. Inc., Chemicals Division, 15 W. 51st St., New York 19, N. Y.*

Polyester resin. Properties, uses, chemical resistance, gel and reactivity times at various bath temperatures, properties of glass mat and glass cloth laminates, viscosity graphs, and other technical data on Atlac 382 polyester resin. "Properties and Uses of Atlac 382 Polyester Resin." "Room Temperature Curing System for Atlac 382." Both 12 pages. *Atlas Powder Co., Chemicals Div., Wilmington 99, Del.*

Electronic control equipment. "A Functional Guide to AutroniC Control Equipment." Bulletin A-913. 8 pages. *Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.*

High capacity feeder. Features, operating principles, dimensions, uses, etc., for Hi-Weigh Model 37-20 belt gravimetric feeder for continuously weighing and feeding dry materials at high rates. Bulletin 35.20-2. 4 pages. *B-I-F Industries Inc., 345 Harris Ave., Providence 1, R. I.*

Polyurethane motion picture. "New Dimensions in Comfort" is a 13½-min. sound and color movie featuring the benefits and sales advantages of polyurethane foam for the furniture retailer, buyer, manufacturer, and consumer. Available without charge. *Public Relations Dept., Allied Chemical Co., National Aniline Div., 40 Rector St., New York 6, N. Y.*

Electric eyes. Applications, specifications, and other data for a line of electric eyes for counting, sorting, monitoring, assembling, and automatic weighing. Bulletin 571. 16 pages. *Photomation Inc., 96 S. Washington Ave., Bergenfield, N. J.*

Industrial weighing systems. Data on the basic art of weighing, accuracy in weighing systems, the Emery "rolling ball" head, and the instrumentation used with modern weighing systems. Four folders of 4 pages each. *The A. H. Emery Co., New Canaan, Conn.*

Pigments. Data on natural and synthetic pearl pigments; **(To page 172)**

dispersion and orientation of pearl crystals; choice of pigment types; formulations available for various applications; and application procedures. 8 pages. *The Mearl Corp., 41 E. 42nd St., New York 17, N. Y.*

Nylon. Properties, characteristics, standard formulations, etc., for Spencer nylon. 6 pages. Price List. 4 pages. *Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.*

Rigid PVC. Properties, applications, etc., for Kaykor rigid polyvinyl chloride products. Catalog RV-59. 24 pages. *Kaykor Industries Inc., Yardville, N. J.*

Compression molding presses. Specifications, uses, etc., for a line of 60-, 75-, 100-, 150-, 175-, 200-, 300-, and 450-ton automatic compression molding machines. 8 pages. *Baker Brothers Inc., Toledo 10, Ohio.*

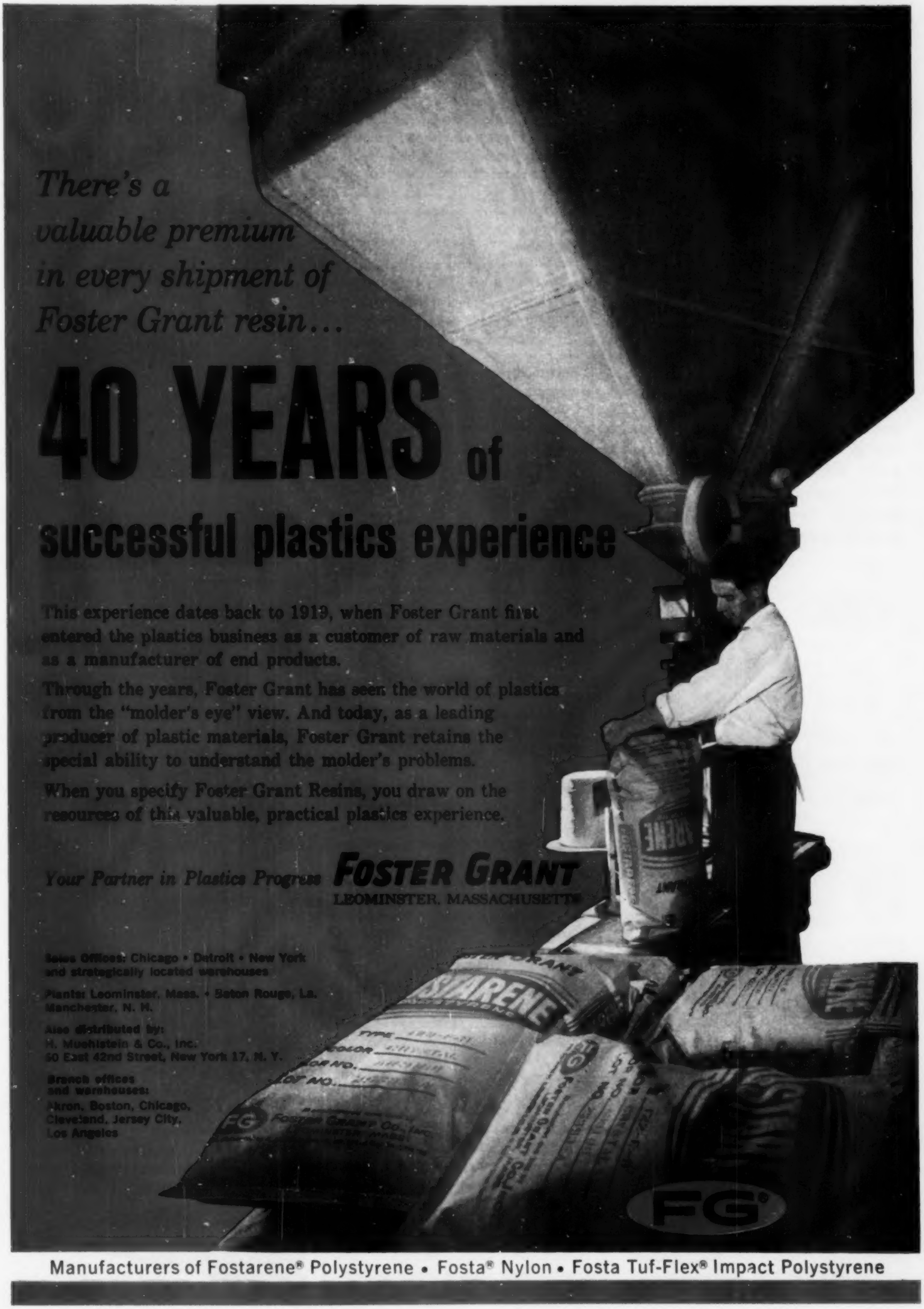
Industrial vacuum equipment. Models available, uses, etc., for a line of vacuum equipment, which is used for pneumatic conveying of plastic pellets, cleaning boiler tubes, removing used coolant from machine sumps, and other vacuum cleaning tasks. 4 pages. *Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.*

Synthetic Resins and Plastics in the Chemical Industry illustrates a wide range of applications for the manufacture of protective clothing and as packaging materials for chemical products; indicates special properties of plastics that make them suitable for a variety of similar applications. 18 pages. *Information Department, Distillers Plastics Group, Devonshire House, Piccadilly, London W1, England.*

Valves. Wall chart describes line of valves, connections normally used, installation and maintenance tools, installation, and operation and maintenance. 2 pages. *Lunkenheimer Co., Cincinnati 14, Ohio.*

Teflon sheets, rods, and tubes. Properties, sizes, heat resistance, toughness and flexibility, chemical inertness, uses, etc., for a line of Teflon sheets, rods, and tubes. Fact Sheet 3. 4 pages. *Chemplast Inc., 3 Central Ave., East Newark, N. J.*

Baking finish. "Uni-Clad, a New Super-Tough Chemically-Resistant Baking Finish" describes the advantages, uses, etc., of this coating, which is applied by dip, conventional spray, electrostatic spray, or electrostatic disk. Baking schedule is 30 min. at 300° F. 4 **(To page 174)**



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pages. *Universal Paint & Varnish Inc., Bedford, Ohio.*

Tool and die steels. "Your Guide to Selection of Specialty Steels" contains information on tool and die steels; stainless steels; high temperature alloys; electronic, magnetic, and electrical alloys; special-purpose alloy steels; tubing and pipe; and fine wire specialties. 40 pages. *The Carpenter Steel Co., Reading, Pa.*

Pigments. "Ferro Silicone Colors for Silicone Base Paint and Silicone Rubber" gives colors available, prices, etc. 3 pages. *Plastic Color Section, Ferro Corp., 4150 E. 56th St., Cleveland 5, Ohio.*

Extruded shapes. Describes advantages, uses, limitations, etc., of nylon, Delrin, and Penton extruded shapes or precision fabricated parts, including a description of the company's extruding facilities. 4 pages. *National Vulcanized Fibre Co., 1059 Beech St., Wilmington 99, Del.*

Testing machines for plastics. Specifications, uses, features, accessories, etc., for a line of testing machines for the plastics industry. Bulletin 59. 32 pages. *Tinius Olsen Testing Machine Co., Easton Rd., Willow Grove, Pa.*

Counters. Describes a line of heavy-duty counters for indication, recording, and automatic regulation of material flow. Bulletin 0159. 4 pages. *Richardson Scale Co., Clifton, N. J.*

Fibrous glass panel industry. "Marketing Strategies in the Fiberglass Panel Industry" is a doctoral thesis by William Fain Egloff, Vice Pres., Asphalt Corp. of America, 130 N. Wells St., Chicago 6, Ill. Abstracts available from author. Thesis on file at Deering Library, Northwestern University, Evanston, Ill.; Library of Congress, Washington, D. C.; and library of The Society of the Plastics Industry Inc., 250 Park Ave., New York 17, N. Y. Copies can be purchased from University Microfilms Inc., 313 N. 1st St., Ann Arbor, Mich. Microfilm: \$6.20. Book form (8½ by 11): \$21.80. Order No. MIC 59-206. 485 pages.

Fatty Acids in Modern Industry. Lists specifications for basic fatty acids for industry. 26 pages. *A. Gross & Co., 295 Madison Ave., New York 17, N. Y.*

Thermistor probes. Describes a line of thermistor probes for use in YSI Thermistemp remote reading Tele-Thermometers and **(To page 176)**

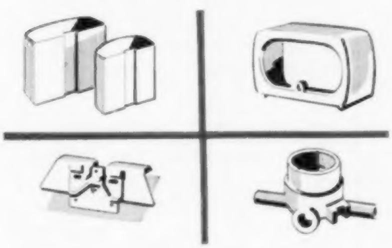
Thermaflow® Tips

News about high-strength molding compounds

Atlas Powder Company, Wilmington 99, Delaware
In Canada: Atlas Powder Company, Canada, Ltd., Brantford, Ont.

New Thermaflow 105 saves 20% over other high-strength plastics

If you've been interested in using high-strength plastics in products now made of metal or conventional plastics—but found the price tag too steep . . . here's news. New Thermaflow 105 reinforced polyester premix gives you a balance of strength, moldability, surface finish, chemical and electrical properties—at a cost about 20% lower than other high-strength compounds. It's the best buy yet in terms of strength per dollar.



An "idea" material

This new combination of performance and price opens up endless new design possibilities. Use it for new quality and economy in TV and radio cabinets, air conditioner housings, appliance parts, instrument cases, tubes, buckets, panels, tanks. You name it . . . we'll help you do it.

Take a look at the characteristics listed here. Remember—you'll get maximum benefits when you design to utilize its high-strength, corrosion resistance, and consistently high quality to the utmost. It's easy to use, too . . . pulls apart readily to load in molds, and has long stability in storage.

MOLDED PROPERTIES

Specific gravity	1.87
Flexural strength, psi	
*ASTM bar	20,000
**Cut specimen	16,000
Flexural modulus (psi x 10^6)	1.6
Izod impact-notched, ft./lbs./in. notch	
*ASTM bar	12.0
**Cut specimen	4.5
Compressive strength, psi	18,000
Heat distortion point, 264 psi	>450° F.
Barcol hardness	65
Water absorption, %	
24 hours @ 23° C.	0.14%
24 hours @ 100° C.	0.75%

*ASTM bar—Test results achieved with a sample molded under ideal laboratory conditions to achieve maximum strength.

**Cut specimen—Test results achieved on a number of samples cut from molded parts at random direction to any possible glass alignment. Results reported are the average of several tests.

NOTE: Common practice reports test results in terms of the maximum values available under ideal conditions "ASTM bar" figures are listed here to permit comparison of Thermaflow 105 with other similarly reported materials.

ELECTRICAL PROPERTIES

Arc resistance, sec.	130 sec.
Dielectric strength (1/8" thick)	
v/mil short time	230 v/m
step by step	210 v/m
Dielectric constant (1 mc.)	5.05
Dissipation factor (1 mc.)	0.009

STRENGTH RETENTION

	Flexural Strength, psi	Flexural Modulus x 10^6	Appearance
Original sample	16,000	1.58	—
24 hours H_2O @ 100° C.	After Test 13,400	After Test 1.21	excellent
24 hours 10% boiling NaOH	13,800	1.09	good
24 hours 10% boiling HCl	10,500	0.87	surface good—pigment bleached white

Price Schedule (f.o.b. Wilmington; Net 30 days)

Standard Colors: grey, tan, black

1 carton — (80 lbs.)	— $ .64/lb.
5 cartons — (400 lbs.)	— .48/lb.
24 cartons — (1,920 lbs.)	— .42/lb.
120 cartons — (9,600 lbs.)	— .41/lb.
252 cartons — (20,160 lbs.)	— .40/lb.
less than 1 carton	— 1.00/lb.

Get full facts today—

Write for catalog of Thermaflow materials, and for case histories of their use by leading molders.

Controllers, or for use as component transducers in special instrumentation. 6 pages. *Yellow Springs Instrument Co. Inc., Yellow Springs, Ohio.*

Facts on Phenolics. Lists physical properties, uses, etc., for 33 phenolic and three diallyl phthalate molding compounds. 16 pages. *Durez Plastics Div., Hooker Chemical Corp., N. Tonawanda, N. Y.*

Government publications. Printed editions of the commercial standards for ABS plastic pipe: CS218-59 covers requirements and methods of test for rigid ABS pipe (IPS dimensions), price 10 cents; CS219-59, dimensions and tolerances for solvent welded ABS pipe, price 5 cents; CS220-59, dimensions and tolerances for lightweight ABS pipe, price 5 cents. "Investigation of Design Criteria for Cushioning Materials," including several samples of fibrous glass and polyurethane. PB 151720. 34 pages. Price: $1.00. "Control of Variables in Heat Resistant Glass Reinforced Plastics — Vol. 1." PB 151802. 62 pages. Price: $1.75. PB 151803, same title, Vol. 2, engineering report. 580 pages. Price: $7.00. *OTS, U. S. Department of Commerce, Washington 25, D. C.*

Commercial standards. Lists all commercial standards, including those for plastics, as revised to July 1, 1959. Catalog 978. Single copies free. *Commodity Standards Div., U. S. Department of Commerce, Washington 25, D. C.*

Tensile tester grips. Description, capacity, specifications, etc., for five sets of tensile tester grips. Bulletin 101-TT. 4 pages. *Thwing-Albert Instrument Co., Penn St. at Pulaski Ave., Philadelphia 44, Pa.*

Heating cylinders. "Operating Suggestions for IMS Vented Reverse Flow Heating Cylinders." 4 pages. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

PE line wire covering. "Case for Polyethylene Line Wire Covering" compares mechanical and other properties of polyethylene, neoprene, and URC. 4 pages. *U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, N. Y.*

Pulverizer. Flowsheet and operating information on the Pulver-Mill, a vertical impact mill with an integral air classifier, which has plastics, chemicals, and other applications. Bulletin 093. *Sturtevant Mill Co., Park and Clayton Sts., Boston 22, Mass.*—**End**

Plastics Digest

(From pp. 54, 56)

of phenol-formaldehyde, and the synthesis of condensates, consisting of uniform molecules of defined constitution, as well as the synthesis of poly-oxybenzyl ethers with two- or three-dimensional cross-linkings, consisting of nonuniform molecules, the units of which are uniform, are described. These products allow an easy and clear examination of the correlations between the physical as well as the chemical properties and the constitution of phenol-formaldehyde condensates.

Interfacial polycondensation, a versatile method of polymer preparation. P. W. Morgan. SPE J. 15, 485-95 (June 1959). Detailed procedures for interfacial polycondensation are presented. The mechanism and nature of the polymerization, and the selection of optimum polymerization conditions are discussed. The application of the theories to the preparation of polyamides, poly-urethanes, poly-sulfonamides, and poly (phenolesters) are given. The polymerization techniques are also applicable to the preparation of various types of ordered copolymers.

Publishers' addresses

Angewandte Chemie: Verlag Chemie GmbH, Pappelallee 3, Weinheim/Bergstr. (17a), Germany.

Annali de Chimica: Viali Liegi 48, Rome, Italy.

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

Chemical and Engineering News: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.

Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York 20, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.

Journal of American Concrete Institute: American Concrete Institute, P. O. Box 4754, Redford Station, Detroit 19, Mich.

Journal of Chemical Physics: American Institute of Physics, 57 E. 55th St., New York 22, N. Y.

Modern Hospital: F. W. Dodge Corp., 919 N. Michigan Ave., Chicago 11, Ill.

Modern Packaging: Modern Packaging Corp., 575 Madison Ave., New York 22, N. Y.

Plaste u. Kautschuk: VEB Verlag Technik, Unter den Linden 12, Berlin NW7, Germany.

Plastics (London): Temple Press Ltd., Bowling Greene Lane, London EC1, England.

Plastics Technology: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.

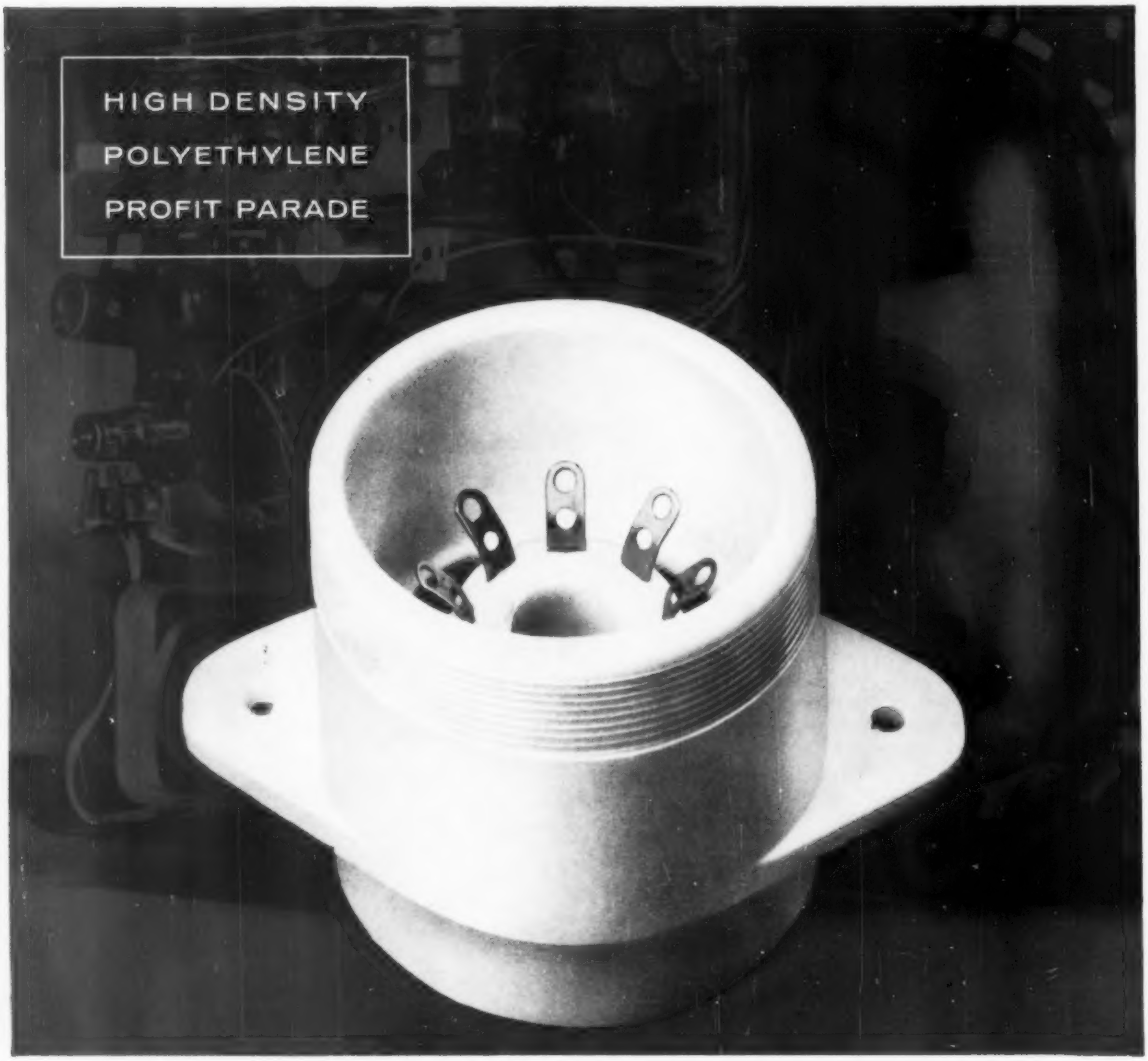
Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.

Rubber Age: Palmerton Publishing Co., Inc., 101 W. 31st St., New York 1, N. Y.

Rubber and Plastics Age: Rubber and Technical Press Ltd., Gaywood House, Great Peter St., London SW1, England.

Rubber World: Bill Brothers Publishing Corp., 630 Third Ave., New York 17, N. Y.

SPE Journal: Society of Plastics Engineers, Inc., 65 Prospect St., Stamford, Conn.—**End**


HIGH DENSITY
POLYETHYLENE
PROFIT PARADE

Blow molding

(From pp. 83-88)

portedly running up in the 1500/hr. class. And with some of the unique new multi-cavity molds coming into use, production rates may be increased accordingly. The reduction in piece price through the use of such set-ups has already proved to more than offset extra mold costs.

Reportedly, there are also materials advantages. A blow molded piece, for example, can use a 0.2 to 0.7 M.I. resin, while a similar injection molded part would require an M.I. of 5. Wall thicknesses can be blown thinner than with injection molding.

And in comparison to thermoforming, it is ideal for the production of deep, hollow parts which would thin out too much at the bottom when thermoformed. With blow molding, as described in the text on p. 87, it is possible to turn two parts of this shape out as one piece and then slice them apart.

Just exactly where the new method will find its proper place among the various processing techniques remains to be seen. In some cases, it will replace earlier methods. In others it will broaden the plastics market base by making possible application previously not economically feasible.

The automotive industry offers two cases to illustrate. One is a reservoir for windshield wiper fluid. Originally, glass Mason jars were used for this purpose. Breakage, however, ran so high that automobile companies turned to specially engineered and shaped glass containers—but here the cost factor started to raise problems. The first attempt to use plastics was in the form of a film bag to hold the liquid. Automotive engineers reported, however, that the life of the bags was relatively short. And at this point, blow molding entered the picture. The first attempt in this direction was the obvious use of a conventional-type blow molded container (67) of low-density polyethylene—until the engineering department suddenly became aware of the design potential inherent in the technique. Now in the works for one automobile manufacturer is a unique reservoir that takes advantage of all that blow molding has to offer. The part will be a specially-shaped tank blown over a mandrel to effect double openings (top and bottom) for attachment of the necessary tubing. It will be made of linear polyethylene and will incorporate solid flanges on either side to provide for easy mounting. Functionally, the part should be ideal; cost-wise, the mold will be about $1000; and built-in assembly features bring added economies.

The second is a funnel-shaped component for the automobile heater assembly. First, a light-gage metal was tried; second, an inexpensive filler impregnated with waxes and resins was put on test; and, finally, a compression molded resin-impregnated wood waste product was considered. With all three, it was either the performance or the cost factor that held it back. By switching to a blow molded high-density polyethylene part, company engineers feel that it can provide just the right degree of performance required—with a cost savings of at least one-third.

More and more products

The extent to which the new technique has penetrated the housewares, toys, automotive, and industrial markets is best described by the photograph on pp. 84-85. All 81 applications are commercial products—actually being sold commercially either here or overseas.

Several highlights should be pointed out, however. In the toy field, for example, the range of size from the small novelties on the bottom shelf to the sit-on car and huge fire-hydrant savings bank on the top shelf are indicative of the direction in which the toy field is progressing. The car, which weighs about 3 lb., is molded of high-density PE, has a $\frac{3}{16}$-in. wall, and sells for $8. Similarly high-priced toys, including hobby horses, may soon be entering the market. The possibility of using blow molded component parts of a movable toy also now exists and will shortly be realized by toy manufacturers. Mention should also be made of the doll

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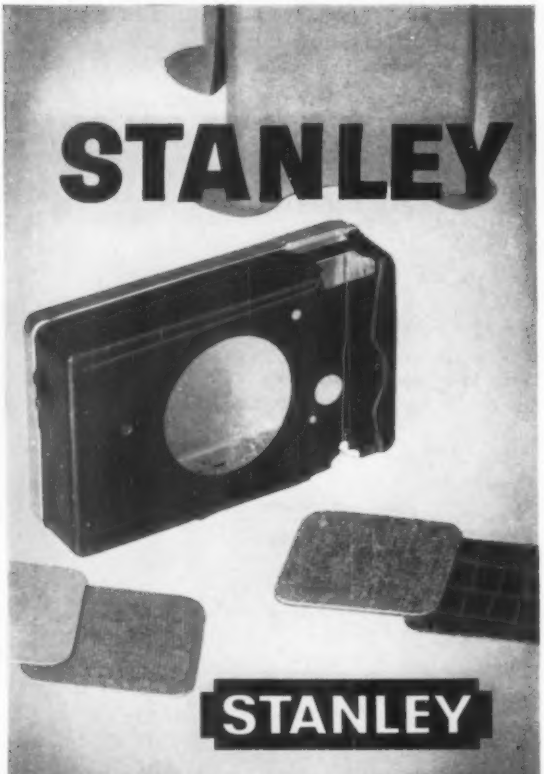

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2-mold model
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- Injection Molder
- Upward Inflation Tubular Film Making Unit
- Extruders - 42, 50 & 75mm
- Extrusion Dies
- Plastic Granulators
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Management: International Exposition Co., 480 Lexington Ave., New York 17, N. Y.

market which has accepted the concept of blow molded bodies and legs (heads are already in the offing) so readily that an annual rate of between 7 and 8 million lb. of high- and low-density PE for this use is expected shortly. Thus far, about 35 toy manufacturing companies have installed blow molding equipment and it is estimated that for high-density PE alone, they can represent a market of between 20 and 30 million pounds.

In housewares, any item that has a neck opening smaller than the body of the container lends itself ideally to blow molding—and this includes such complex items as the carafe (43), the insulated bottle (44), the juice decanter (45), and the bud vase (46). The insulated bottle, as just one example, incorporates a unique double-wall construction in which the outer and inner shells are blown separately and then joined together. Hollow ware housewares of any type are a possibility and garbage pails molded with the lid as one unit are already being tested. Although they will never replace the injection molded pail, they should certainly be able to compete with the cheaper metal units.

Industrial markets

A good many of the industrial products shown on pp. 84-85 were developed in Europe and have yet to be utilized in this country. But the potential they represent is of enormous significance.

The 20-gal. carboy (25), the milk container (26), the 1½-gal. gasoline can (27), and the 5-gal. gasoline can (28)—all molded of high-density polyethylene—straddle an important and as yet untapped area between packaging and industrial applications. It is interesting to note that on both the carboy and the milk container, lugs were blown into the pieces to provide for attachment of the handles. The gasoline tank for a small 2-cycle engine (31) fits into the same grouping and is already being used in England for band saws, lawn mowers, and similar equipment.

The high-density insecticide spray tanks (58 and 62) have stimulated thought about other markets (To page 187)

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MOLDING PRESSES. Illustrated 8-page brochure describes and gives general specifications for a line of automatic molding presses ranging from 60 to 450 tons in capacity. Choice of compression or transfer molding at a switch-turn. Baker Bros., Inc. (K-902)

METAL FLAKE DECORATION. Illustrated 6-page brochure discusses the areas of use for colored metal flakes designed for laminating into plastic sheeting. The Dobeckmun Company. (K-903)

COLOR CORRECTED LIGHTING. Illustrated 4-page brochure describes a line of lighting fixtures designed to simulate north sky daylight. Macbeth Daylighting Corp. (K-904)

PANTOGRAPHIC ENGRAVERS. Illustrated brochures describe a line of pantographic engraving machines and attachments and accessories. These include cutter grinders, electrical markers, copy holders and slides and tracing styles. H. P. Preis Engraving Machine Co. (K-905)

SEMI-BULK HANDLING CONTAINER. Illustrated 4-page brochure describes an invertible steel or aluminum bin for the economical handling and storage and quick emptying of flowable dry products, such as plastic resins. 36, 65 and 88 cu. ft. sizes. Powell Pressed Steel Co. (K-906)

METALLIZED THERMOPLASTIC SHEETINGS. Illustrated 4-page brochure gives applications and color samples of metallized butyrate acetate sheeting for deep and shallow draw forming, available in standard or matched colors. Bulletin describes this method of forming. Gomar Manufacturing Co., Inc. (K-907)

INJECTION PRESSES. Illustrated 4-page brochure gives specifications for a line of injection presses in 2½, 3 and 4-6 oz. capacities. Van Dorn Iron Works Co. (K-908)

DECORATIVE PAINTING EQUIPMENT. Illustrated 32-page catalog on a line of automatic paint spraying and wiping, mask washing, screen painting and roller coating machines, with price list. Description of mask-making service. Finish Engineering Co., Inc. (K-909)

VACUUM PUMP. Illustrated 4-page brochure describes an air-cooled, rotary positive vacuum pump with a radiator-cooled lubricating system. Two sizes; continuous duty; 24 to 29.9 in. Hg. Leiman Bros., Inc. (K-910)

MOLDING COMPOUNDS, RESINS. Illustrated 8-page brochure provides data on properties and uses of a line of thermosetting phenolic and dyallil phthalate molding compounds, fire-retardant polyester resins for reinforced plastics and phenolic resins for bonding and coating. Durez Div., Hooker Chem. Corp. (K-911)

RIGID PLASTIC SHEETINGS. 12-page bulletin describes a group of rigid sheetings including unplasticized polyvinyl chloride. Gives physical properties, chemical resistance charts, design helps, fabrication tips, etc. Seiberling Rubber Co., Plastics Div. (K-912)

ACRYLONITRILE-BUTADIENE-STYRENE POLYMERS. Illustrated 8-page brochure gives properties and applications of a family of ABS plastics which can be molded, extruded or vacuum formed. Offers high impact strength, heat resistance, good electrical properties, dimensional stability. Marbon Chem. Div., Borg-Warner. (K-913)

URETHANE FOAM. Illustrated 24-page brochure discusses the properties and applications of urethane foam as used in upholstery, protective packaging, garment insulation and a variety of housewares. Du Pont. (K-914)

PRODUCTION, CHECK WEIGHING. Illustrated 8-page brochure describes a line of production scales in capacities between the extremes of 50 grams and 100 lbs. Also a checkweigher, up to 100 lbs. and high-sensitivity and high-speed production models. Exact Weight Scale Co. (K-915)

SAFETY SWITCHES. Illustrated 16-page catalog describes a line of hand and foot operated micro switches to protect personnel and equipment during machine operation. Details a variety of installations. Micro Switch Div., Minneapolis-Honeywell Regulator Co. (K-916)

TONERS. Series of folders gives general data on individual colors formulated for use in vinyl plastics or polystyrene, methacrylate, butyrate, cellulose acetate and most thermosetting plastics. Zinsser & Co., Inc. (K-917)

TENSILE TESTER GRIPS. Illustrated 4-page bulletin describes five different sets of tensile strength testing grips for strips or sheets of plastic and other materials. Thwing-Albert Instrument Co. (K-918)

SILICONE ANTIFOAMS. Illustrated 8-page brochure discusses the causes and control of foaming and describes a series of silicone defoamers for aqueous and non-aqueous systems. Recommends equipment and methods for best performance from chemical defoamers. Silicone Products Dept., General Electric. (K-919)

MICROMETERS. Three illustrated brochures describe a line of motorized and manually operated dead weight micrometers for measuring film thickness, and for internal and external dimensions of molded pieces, etc. Testing Machines, Inc. (K-920)

TRIMMING AND PIERCING PRESSES. Illustrated 4-page brochure gives specifications for a trimming and piercing press for vacuum-formed plastics. Models in capacities of 75, 100, 150, 200 and 300 tons. Dake Corp. (K-921)

LAMINATOR. Illustrated bulletin sheet describes a general purpose laminator for plastic films and other sheetings. Takes film up to 65½ in. wide. Speeds up to 600 FPM for general converting, up to 1000 FPM on special applications. John Dusenbery Co., Inc. (K-922)

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CUSTOM MOLDING. Illustrated 4-page brochure describes the facilities of an injection molder and the engineering and design services offered. Presses range in size from 4 to 48 oz. capacity. Yardley Molded Plastics, Inc. (K-924)

INJECTION MOLDER. Illustrated 4-page brochure and specification sheet describe a 12/16 oz. injection machine with a plasticizing capacity of 150 lbs./hr. 520 dry cycles per hr. Lombard Governor Corp. (K-925)

ADHESIVE MELTER. Illustrated data sheet describes an electric melter for freeing adhesives from drums and storing the hot melt. Frees and stores 50 to 100 lbs. 150 to 450°. Sta-Warm Electric Co. (K-926)

INJECTION MOLDERS. Illustrated brochures and specification sheets describe a line of injection machines in capacities of 30/50 grams and 2/3, 4/6, 8/10, 12/16, 16/20 and 28/32 ozs. Improved Machinery, Inc. (K-927)

BAG SEALING. Series of folders and brochures describes a line of bag sealers for a variety of films. Types include rotary hand, foot jaw, continuous band, rotary heat and an automatic jaw sealer-labeler. Also conveyors. Doughboy Industries, Inc. (K-928)

DENSITY MEASUREMENT SYSTEM. Illustrated 12-page brochure describes and gives specifications for a system providing continuous measurement of the density, specific gravity, percent solids, concentration or related quantity of a flow of liquids, slurries or divided solids, without physical contact with material. Industrial Nucleonics Corp. (K-929)

THE USE OF ORGANIC PEROXIDES. 12-page reprint of a report to the 11th Annual Meeting of the Reinforced Plastics Division on the use of organic peroxides in the reinforced plastic industry. Diagrams, tables. Lucidol Div., Wallace & Tiernan, Inc. (K-930)

INTERIOR PAINTS. 30-page technical bulletin covers in detail the performance of a styrene-butadiene copolymer latex designed to improve interior paints at low cost. Pictures, graphs and charts show results of various tests. Plastics Div., Koppers Co., Inc. (K-931)

INJECTION MOLDERS. Illustrated 54-page catalog describes a line of injection machines for a wide range of products, capacities up to one ounce (1½ ozs. for certain applications). Custom-building available. Price list. Newbury Industries, Inc. (K-932)

ITACONIC ACID. 20-page technical bulletin discusses the uses and properties of itaconic acid. Graphs, tables, formulae. Chas. Pfizer & Co., Inc. (K-933)

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VALVES. Illustrated catalog describes a line of hydraulic, steam and air valves, including two-pressure hydraulic, high-pressure inlet, 2-, 3- and 4-way, double-acting cylinder, air pilot and other types. Price list. Sinclair-Collins Valve Co. (K-935)

CONVERTING MACHINES. Illustrated 24-page brochure lists a complete line of converting machinery and engineering services available. Lists technical bulletins covering individual coating, cooling, embossing, laminating, printing, rewinding, unwinding, waxing and other machines. Dilts Div., Black-Clawson Co. (K-936)

MIXING, GRINDING EQUIPMENT. Illustrated 4-page brochure describes this company's lines of mixers, agitators, kneaders, vacuum dryers, blenders, grinders, batch mills, etc. Patterson Foundry & Machine Co., Div. of Ferro Corp. (K-937)

ELECTRIC CARTRIDGE HEATERS. Illustrated catalog sheet describes features of a line of electric cartridge heaters for stud heating, stress-relieving, extruding metals, and metal forming. Includes specifications, prices. Edwin L. Wiegand Co., Inc. (K-938)

CONVEYORS. Companion illustrated brochures describe and give case histories of a roller conveyor with automatic elevator, a chain conveyor, roller and incline-pusher conveyors, vertical conveyors, etc. C. M. Wilkinson Co. (K-939)

EXTRUDING EQUIPMENT. 6-page illustrated brochure describes a line of 1- to 8-in. thermoplastic extruders. Machines feature balanced heat control, quick-opening die gates and torpedo-type screws. National Rubber Machinery Co. (K-940)

INJECTION MOLDING EQUIPMENT. Illustrated catalog gives specifications and prices for grinders, drum tumblers, automatic mold circulators, mold fillers, drying ovens, mold releases, etc. Injection Molders Supply Co. (K-941)

POLYURETHANE ELASTOMER. 22-page technical bulletin on a polyurethane elastomer which will not crystallize and has good creep properties, resistance to hydrocarbons, low-temperature performance, high-temperature stability and abrasion resistance. General Tire & Rubber Co. (K-942)

INJECTION MACHINE. 4-page illustrated brochure describes a 4-oz. injection press with 100 lbs. styrene plasticizing capacity per hr., and a speed of 840 dry cycles per hr. The Van Dorn Iron Works Co. (K-943)

OPTICALLY CLEAR PLASTIC. Illustrated 4-page brochure discusses the uses and lists the physical properties of a colorless thermosetting plastic in rigid sheets, said to have the abrasion resistance of glass and good high and low temperature characteristics. Cast Optics Corp. (K-944)

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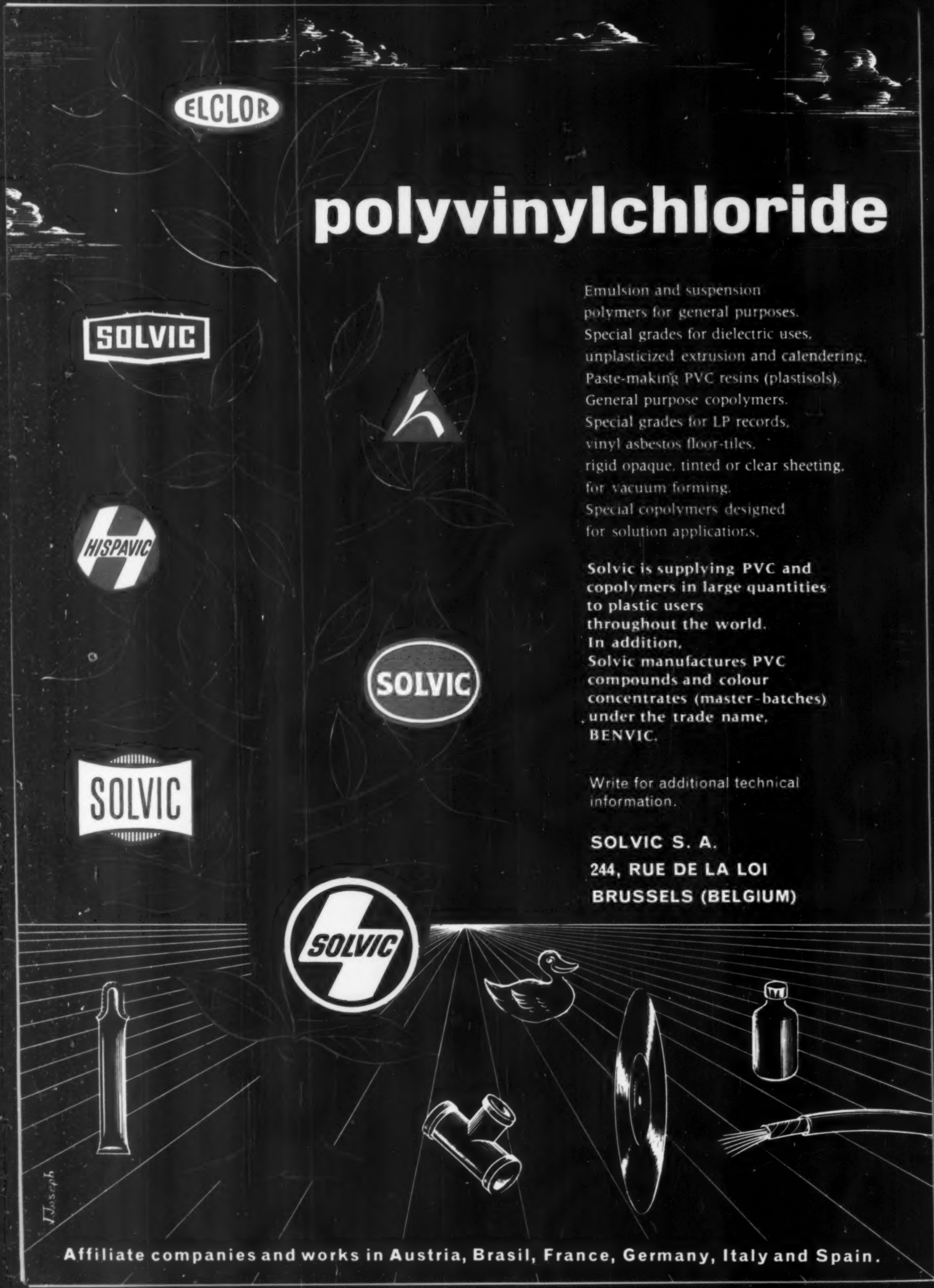
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and the blow molded paint brush handle (76) has given rise to talk about doorknobs, screw driver handles, and so on. As far as the paintbrush handle is concerned, the present market is estimated out at about 100 million new handles a year. The majority of these are wood, but a number are injection molded. Due to faster cycling, less costly molds, and generally lower operating costs, it seems likely that the blow molded handle can compete with the injection molded type and may conceivably hit markets that wood is now enjoying.

As for screw driver handles, a method has already been suggested for insert blow molding. It is felt that a solid rod or bar could be inserted (either by handloading or automatic indexing) into the parison. Basically, the tube would extrude over the rod, the molds would close, locking the insert in place, and a needle would blow the handle out on the upper part of the tube.

Nor can the wheel shown on p. 87 as a toy item be left out of any discussion of industrial applications. Although it is now looked on as a toy, other possibilities for it are obvious. Here you have a wheel in which the hollow wheel area, the tire rim, and even the bearings are *molded in one piece*. Made of high-density polyethylene, it has considerable strength and there is no reason why it couldn't be used for lawn mowers, golf carts, or any similar small, movable object.

It is the large-volume automotive field, however, that has really captured the imagination of the blow molder. Estimates of 3 lb. of blow molded products per car by 1961 are already being heard. The windshield washer tank (67), the air intake silencer parts for a carburetor (68, 69, 70, 72), the brake fluid reservoir (71), and the sun visor (73) are already commercial. The carburetor parts are especially interesting since they have been designed to accommodate an injection molded fitment ring that will enable them to be used on many different models and sizes. Similar pieces are also under test for the ducting in a vacuum cleaner.

Just how much further blow

molding can go in these fields and what the "blue-sky" thinking has already evolved will be reserved for a later article in this series. Suffice it to say that there are areas not yet even touched. To quickly illustrate this, one can point to reports from Japan about trophy bases and statuary blow molded hollow (as a thin shell) and injected with plaster. Going one step further with this premise: if filled hollow shells are feasible, then why not blow mold the entire front door of a refrigerator (both inner and outer panel) and fill it with foam for insulation and structural strength?

It is obvious that blow molding still has a long way to go. Handled right, approached with care and consideration, and built on a bedrock of sound engineering and design data, it can certainly achieve its goal. It is not a solution to all plastics design problems, nor does it seem likely that it is even going to supplant any of the older conventional techniques now in use.

But it *is* here. It is another processing tool that will enable the plastics industry to expand the range of its activities. And it is something for processors and end-users to look into—now!

Acknowledgments

Thanks are due to many who helped in the preparation of this article, and a complete list will be run at the conclusion of the series. For particular help on this phase, however, special thanks to Mr. Thomas W. Mullen of Celanese Plastics Co. (and for permission to use excerpts from his paper on blow molding markets delivered before the recent National Technical Conference of S.P.E. in Los Angeles, Calif.), Mr. Vernon Hill of National Cleveland Corp., and to Mr. R. Bishop of W. R. Grace & Co. The blow molded applications in the photograph on pp. 84-85 were collected by Mr. Mullen of Celanese Plastics.

A full list of machinery manufacturers and custom and proprietary blow molders who helped in gathering data for this series—and especially for the forthcoming article on equipment and techniques—will be listed at the conclusion of this series.—**End**

Delrin applications

(From p. 101)

which accrued to the company through the switch from brass to acetal included the following:

1) By using precision molded parts to replace screw machine brass parts, costs savings on the order of 60% were realized.

2) Because the parts can be molded with greater accuracy than brass could be machined, assembly was simplified and fewer rejects were encountered.

3) Weight reduction (the brass part weighed 7 oz., while the acetal part weighed only 2 oz.) effected shipping economies.

4) Hard water deposits do not cling to acetal.

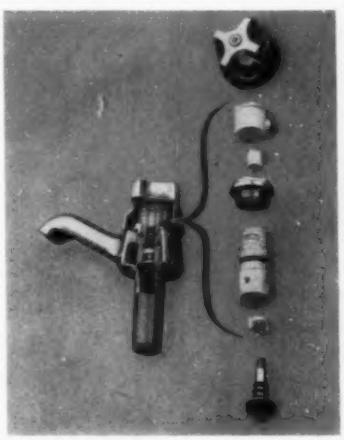
5) The plastic was completely corrosion-resistant.

6) Thermal expansion of acetal is low enough so that it does not affect the operation of the valve within the normal temperature range of water used in the faucets.

7) Because of acetal's insulating effectiveness, the handles on the hot water side do not become uncomfortable to the touch.

According to Kel-Win, brass has been used so long by the industry that the simple introduction of the plastic part represents quite a radical innovation. Chances are there will be some natural industry resistance. But the company feels that the properties of the material are so outstanding that it will eventually make significant inroads into the plumbing and allied fields.

The parts are molded by Dominion Plastics Co., Colonial Heights, Va.—**End**



CUT-AWAY of faucet indicates location of molded acetal internal valve. Disassembled parts at right.

Distribution

(From pp. 104-107)

effective manner. This firm makes extensive use of specially prepared point-of-sale material. Distributors are also backed by a comprehensive national advertising program, which in 1959 covered some 23 consumer and industrial publications having a combined circulation of nearly 20 million. David S. Perry, Filon president, has predicted that industry sales of flat and corrugated reinforced sheeting may reach $100 million annually by 1964.

Filon's glazing panes are an excellent example of how one manufacturer has tailored the product to distribution requirements. These flat reinforced plastic panels, available in clear and several colors, are packed in precut sizes, 50 panes per case, ready for immediate use in replacing broken farm or industrial plant windows. Pre-sizing and packaging eliminates the need to purchase larger sheets and cut out the panes, with consequent waste.

As a major producer of polyethylene film under the VisQueen trademark. Visking Co., Div. of Union Carbide Corp., employs two distribution set-ups. Converters and others in the packaging field are contacted as a group by Visking representatives, with special emphasis on the PE film as a packaging material. To cover the building construction and agricultural field, Visking uses a network of between 800 and 900 distributors. These include lumber and hardware distributors, nursery suppliers, companies specializing in distribution of agricultural products, others who contact construction firms, road building contractors, etc. Through this diverse network of distributors, VisQueen in the proper widths and gages for each use is made available to a complete cross-section of ultimate users.

A full assortment of technical folders, data booklets and other printed material has been prepared by Visking covering all major applications of VisQueen. This material is made available to distributors and is designed to incorporate their imprint.

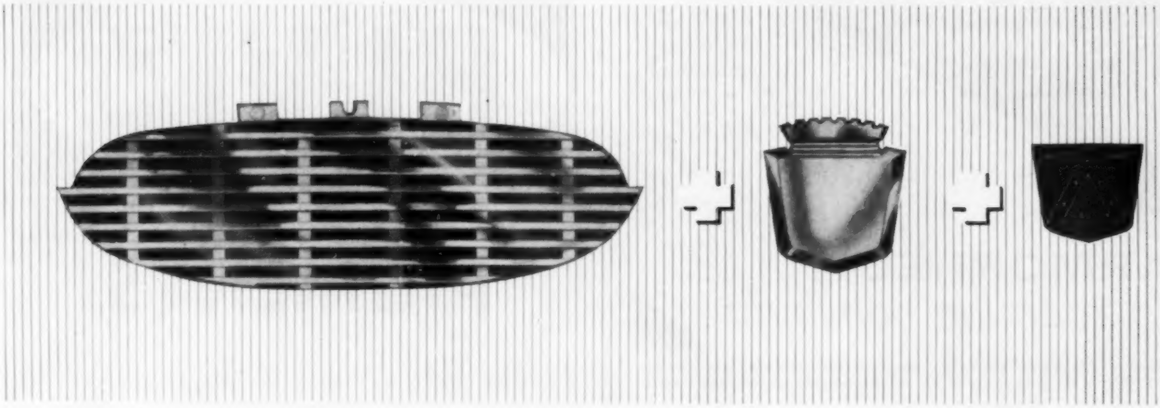
As the plastics industry enters the fiercely competitive 1960s, with its no-holds-barred rivalry among many basic materials, it may find that product technology alone can no longer maintain its dazzling growth record of the past 10 years. Plastics producers must now learn how to sell what they make—at a fair profit—and how to capture some of the bright new big-volume markets.

Only through aggressive, imaginative distribution can these goals be fully attained. And if plastics producers buckle down to this task, who knows? The 1960s may prove to be the decade in which the industry's distribution system catches up with its technology!—**End**

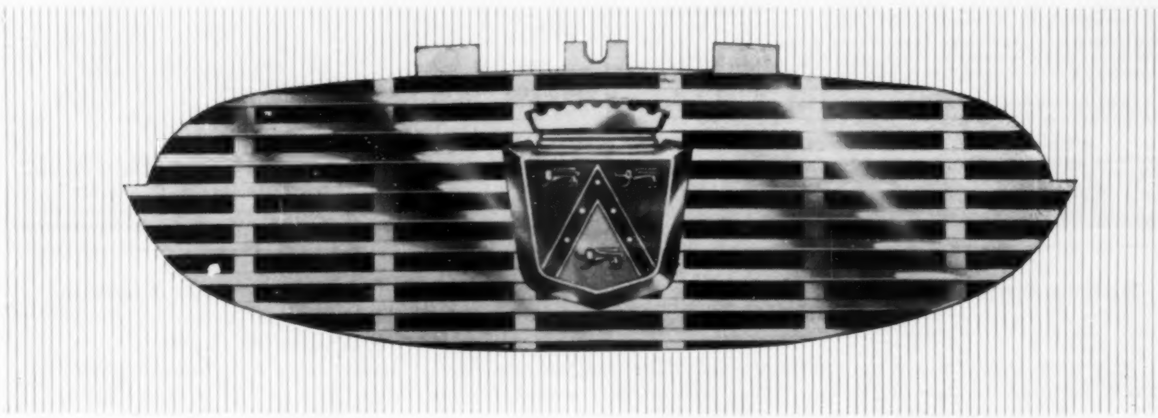
Correction

"Plastics distribution abroad." (MPl, Oct. 1959, p. 85). The name of the author of the article was inadvertently transposed. The correct name is Arthur Herman, President, Commercial Plastics & Supply Corp., New York, N. Y.

Cost of 3-part metal-plastic medallion cut 57%



by switching to this 1-piece PLEXIGLAS molding



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The above example is based on estimated costs . . . and incidentally, saved this company thousands of dollars.

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Set-up time

(*From pp. 126-131*)

to predict fairly accurately the time necessary to allow for set-up in planning a future molding operation assuming that a molding powder of known heat distortion and thermal diffusivity has been selected and that operating heats can be approximated. *Second*, it can be used to check on current molding jobs to see how closely the cooling portion of the cycle being used approached the theoretical limit. Considerable discrepancies here could point out areas of possible improvement in operation provided that a longer cycle is not required by other considerations, such as the elimination of molding defects.

It is important to note that the value chosen for T_c should be close to the temperature of the stock leaving the nozzle. Direct measurement (with a hand pyrometer) will be necessary in some cases where fast cycles cause large differences between stock and cylinder temperatures or when the cylinder heats are different in various zones.

A second point to consider is the shot thickness. It is suggested that the thickest section of the molding be measured and used for the value of *D*. Heat distortion data are usually supplied on all molding powders by the manufacturers. Thermal diffusivity information is not as readily available. The following equation

$$\alpha = \frac{k}{\rho C_p}$$

can be used to estimate a polymer's thermal diffusivity α, where k is thermal conductivity, ρ is density, and C_p is specific heat. For general purpose polystyrene, α is about 1.2 to 1.3 x 10^{-4} sq. in./sec. over the temperature range usually encountered in injection molding. Thermal data for other material can be obtained from the manufacturers of the material that is to be used.

In summary, the effect of injection molding variables and material thermal characteristics on set-up time has been considered both quantitatively and qualitatively. In the latter case, unsteady-state heat-transfer theory has been shown to agree quite closely with experimental data so that practical use of the information plotted in the set-up chart, Fig. 1, appears feasible. The alignment chart on p. 131 has also been constructed from the theory for handy use in practical molding applications.

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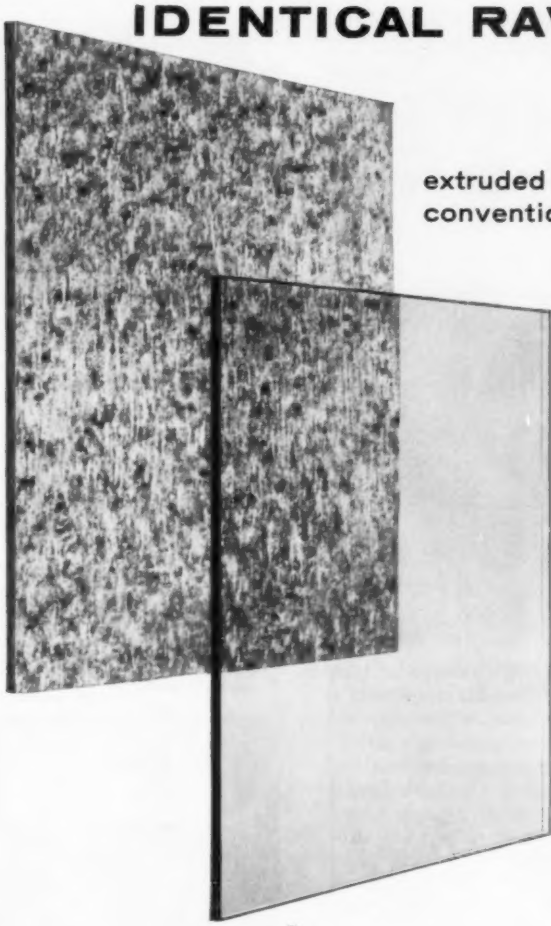
2. E. C. Bernhardt, "Processing of Thermoplastic Materials." Reinhold Publishing Corp., 1959, pp. 355-6.
3. H. P. Gurney and J. Lurie, Ind. and Eng. Chem. *15*, 1170-72 (1923).
4. R. H. Bondy and R. F. Boyer, "Styrene, Its Polymers, Copolymers and Derivatives," Reinhold Publishing Corp., 1959, p. 479, Figs. 10 to 30.
5. R. B. McTaggert, unpublished data 1955.—**End**

IDENTICAL RAW MATERIAL...



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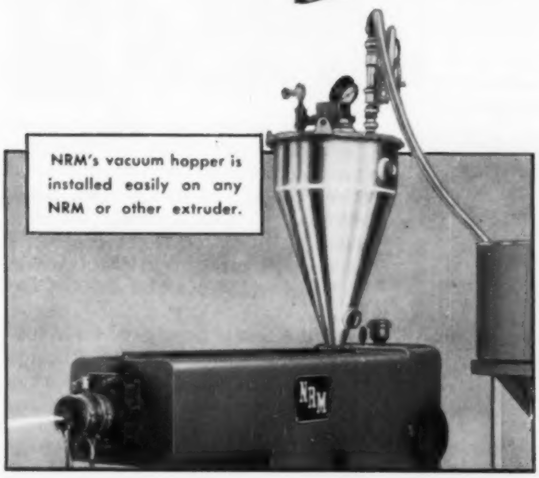

"The results are near-miraculous!" That's what users are saying about NRM's new vacuum hopper.

By removing air, moisture and other volatiles from plastic materials that normally require extensive pre-drying before they are fed into the extruder, NRM's vacuum hopper permits production of bubble-free extrusions from hitherto almost unmanageable materials.

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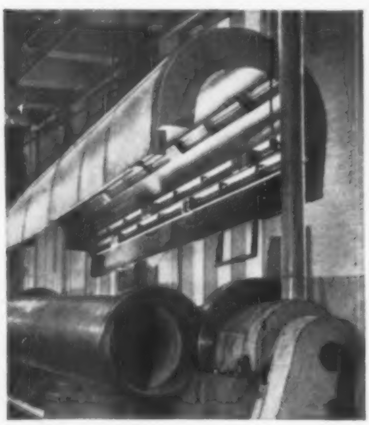
HOW CHROMALOX ELECTRIC HEAT

helps make it...and make it work

...the U.S. Navy's new Mark 32 fibre-glass torpedo launcher

From its unlikely beginning as a fibre-glass mat . . . to its successful operation in sub-freezing sea spray . . . the Mark 32 torpedo launcher testifies to the versatility and dependability of Chromalox electric heat. Designed and built by Apex Reinforced Plastics, division of White Sewing Machine Corp., this lightweight, corrosion-resistant launcher is now in service on Navy destroyer escorts.

Early in production, a Chromalox-heated hood is used in centrifugal molding of the launcher tubes.



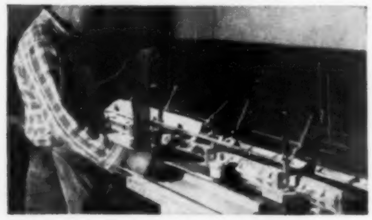
First, a rolled fibre-glass mat is placed inside the mandrel, which is then engaged in spinning motion at 800 rpm. After thermosetting resin has been sprayed into the mandrel, the hood is lowered into position for heat curing. The Chromalox type RAD Far-Infrared Heaters have a total capacity of 36,600 watts, and work reaches approximately 200°F. in about 45 minutes. The hood remains on a total of about $3\frac{1}{2}$ hours, throughout the spinning operation.

Before final assembly, each tube must have steel "nut bars" and "guide bars" cemented to its interior. (Nut bars connect the three tubes into one assembly; guide bars guide torpedoes into the launcher tube.) After these parts are cemented in place, two Chromalox Tubular Heaters wired in series set the cement.

Mounted in a frame which holds them in the center of the tube for its entire length, the 240-volt, 2750-watt heaters are controlled by a Chromalox type AR Thermostat. A small fan attached to the end cap circulates heat within the tube and eliminates condensation.

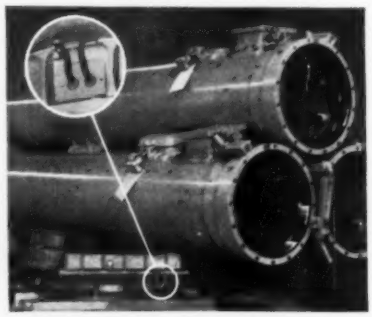
Next, four plastic quadrants are bolted to the tube interior, forming a liner to accommodate $12\frac{3}{4}$-inch torpedoes. To each quadrant are affixed two 101-inch Chromalox Flexible Woven Heaters.

After resin has been applied to the two channels in each quadrant, heaters are laid in place as shown below. The leads are then connected



to a power outlet and the heaters set the cement which bonds them in place. In action, these heaters maintain a protective 50°F. minimum temperature for the torpedo.

The closeup below shows two leads of a circular Chromalox Tubular Heater clamped in a groove around the launcher's swivel base. To prevent formation of ice in the joint between fixed and rotating parts of the base, this heater comes on automatically when the temperature drops below 50°F.



Plastic bottles, containing air at 2000 psi, provide pneumatic force to launch the torpedoes. Fabrication of these bottles, by the unique Apex filament winding process, involves still another Chromalox Heat application. After the plastic bottle has been formed around a Cerro-alloy ball mold, the alloy must be melted from the bottle's interior. Four sets of Chromalox Strip Heater Bands and a Chromalox Ring Heater provide booster heat on the steam-heated vat used for this purpose.

Perhaps one of these heaters, or one of the 15,000 other types, sizes and ratings of Chromalox Heaters can answer your need for heat. For personal assistance and specific recommendations, *Call your Chromalox Man for the Answers*. He's listed at the right.

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Sawing plastics

(From pp. 132-139)

stages in the dulling of a carbide tooth, and indicates the proper time to sharpen the tooth. As the corners of the tooth wear and become rounded, the blade becomes duller and loses its bite. As this happens the teeth become progressively rounder; the saw progressively duller. (See Fig. 6, p. 139.) If one waits too long before resharpening, the rounding of the tooth becomes severe and more of the tooth must be removed in sharpening in order to square off the tooth.

Special saws

Where the plastic to be cut has an abrasive reinforcement or filler such as fibrous glass, aluminum oxide, or silicon carbide, it is necessary to use cut-off wheels with bonded diamond particles on the cutting edge rather than teeth of carbide or steel. Coarse diamond particles well projected from an electroformed bond are most efficient.

When possible an ample supply of liquid coolant should be provided to prevent clogging (loading) the diamond wheels. Where the work must be kept dry, an air blast can be substituted for the liquid coolant, directed at the cutting area to clear the grinding dust or sludge from the cut. If loading or clogging of the wheel should occur in the dry cutting operation, the cutting edge can be cleaned with solvent; do not use dressing sticks.

In using the diamond wheel, as with the carbide or steel saw, cutting speed is important. It has been shown that linear peripheral speeds ranging from 10,000 to 15,000 surface feet per minute are most efficient. Feed speed is also important and will vary with the thickness and density of the material to be cut.

When compared to carbide tools, diamond tools have some disadvantages. The feed is very much lower and the finish is generally not as fine. When cutting relatively thin material with a low glass content, carbide tools are generally preferable. However, the life of the diamond tools is considerably longer.—**End**

Reinforcing action

(From pp. 143-152)

pickup assembly are fastened rigidly to a massive steel plate which, in turn, is mounted on coil springs on the bottom of a forced-convection air oven. The pickup and driving assembly can be moved toward and away from the sample by means of a micrometer extension outside of the oven. Temperatures are measured by means of a thermocouple covered with 1/16-in. of epoxy-glass insulation, shown emerging from a hole in the clamping vise in Fig. 7. The insulation covers the thermocouple leads all the way back to the point where they emerge from the oven. Apparently, the temperature of the insulated thermocouple is nearly the same as that within the specimen, because when the oven temperature is changed, the measured temperature and the resonance frequency of the specimen approach equilibrium at very nearly the same rate.

In conducting a test, the frequency of the current in the driving coil is adjusted until the specimen resonates. Resonance is observed with the aid of an oscilloscope at whose vertical input the amplified signal from the pickup is applied and at whose horizontal input the signal from the audio-frequency generator is applied. Since the specimen is attracted by the electromagnet twice during each cycle of drive frequency, the resonant frequency is twice the corresponding drive frequency, and the Lissajous pattern at resonance is a bow-tie. In initial measurements at room temperature, the current in the drive coil is adjusted until the specimen strain at resonance is 0.1 to 0.2 mils/in., as observed with a micrometer eyepiece microscope. The drive frequency is read to 0.1 cy./sec. on a frequency counter. The driving frequency is next detuned on both sides of resonance in order to determine the frequencies at which the amplitude of the specimen deflection is half that at resonance. Thereafter, the oven temperature is increased 15° to 20° C. in 20 min., and the drive frequencies at resonance and at the half amplitude points are again determined.

E′ and E″/E′ can be calculated from the driving frequencies at resonance, f_d, and at the half amplitude points, f_m and f_l, on the basis of the equation of motion for forced, sinusoidally varied deformation (10). In calculating E′, allowances are made for the geometry of the specimen by treating it as a cantilever beam having one fourth of its weight, plus the clip weight, concentrated at its free end (17):

$$E' = \frac{f_d^2 L^3}{bd^3} [36.08C + 1.48\,(bd\,L)_{23}\,(S)_{23/23}] \times 10^4 \qquad \text{Eq. 1}$$

wherein E′ is in p.s.i., f_d is in 10^2cy./sec., b and *d* are the width and depth of the specimen in 10^1 in., *L* is the effective overhanging length of the specimen in in., *C* is the weight of the clip in *g.*, and $(S)_{23/23}$ is the specific gravity of the sample material. The peculiar units used in Equation 1 serve to simplify computa-

tions on a desk calculator. The working expression for E″/E′ is:

$$\frac{E''}{E'} = 0.28867\left(\frac{f_m^2 - f_1^2}{f_d^2}\right) \quad \text{Eq. 2}$$

Acknowledgments

The writer is indebted to Mr. H. T. Plant, who arranged for the preparation of test materials, to Mr. F. M. Beck, who made the photomicrograph in Fig. 2, to Mr. W. V. Olszewski and Mrs. W. G. Spodnewski for conducting some of the tests, and to Mr. J. A. Coffman and Drs. B. H. Zimm, F. P. Price, and A. M. Bueche for helpful discussions.

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Chlorine content

(From pp. 154-159)

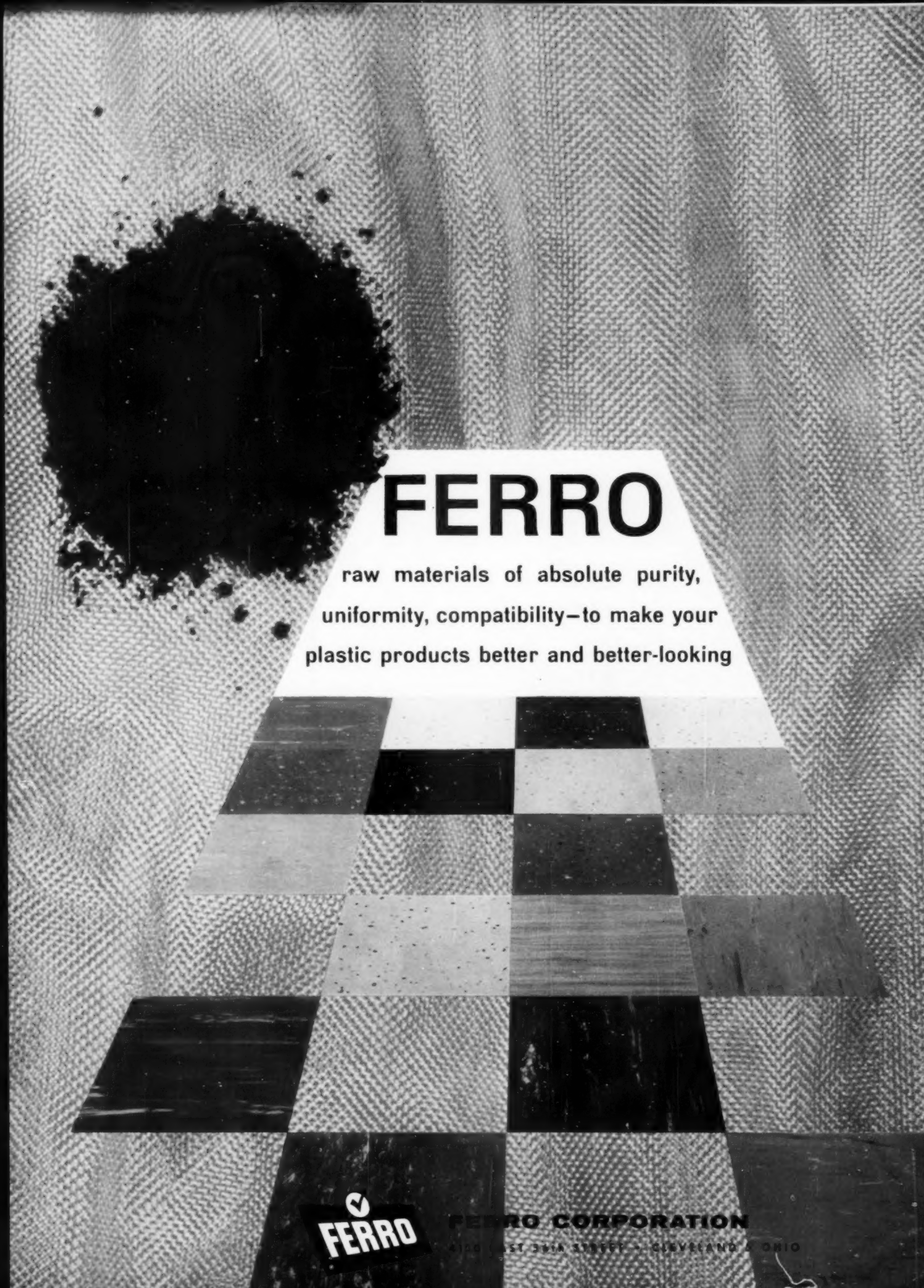
than with the aromatic amine cured resins. This may be due to the fact that TETA, like most aliphatic amines, is a stronger nucleophilic reagent than either of the aromatic amines, and as a consequence it may have undergone a more complete reaction with the chlorine in the epoxide resin. With TETA as a curing agent Resin A exhibits slightly better electrical properties than Resin B, and both of these resins are considerably better from the standpoint of electrical properties than either Resins C or D. It seems quite probable that to a large extent the differences in electrical properties with this series of resins can be attributed to the differences in the chlorine contents of the epoxide resins since the differences in heat distortion temperature of the cured resins are quite small.

Methyl Nadic anhydride (MNA)

The physical and electrical properties of Resins A, B, C, and D cured with MNA are listed in Table II. With each resin 90% of the stoichiometric quantity (one equivalent of carboxyl group per epoxide group) of this converter and 2.5 p.h.r. of DMP-10 (an activator manufactured by Rohm & Haas) were used. The resins were cured by heating for 2 hr. at 93° C., followed by a postcure of 2 hr. at 200° C.

As in the case of the previously described resins, the only physical property appreciably affected by the varying chlorine content resins is the HDT. However, unlike the amine cured resins, Resin A has a lower HDT than either Resins B or C and the difference in HDT between Resins B and C is quite small. The lower HDT obtained with Resin A may be attributed to the quantity of MNA used as a curing agent, since no effort was made during the course of this work to determine the optimum concentration of MNA to be used with this resin.

There is essentially no difference between Resins A and B in this series in elevated temperature electrical properties. The electrical properties **(To page 207)**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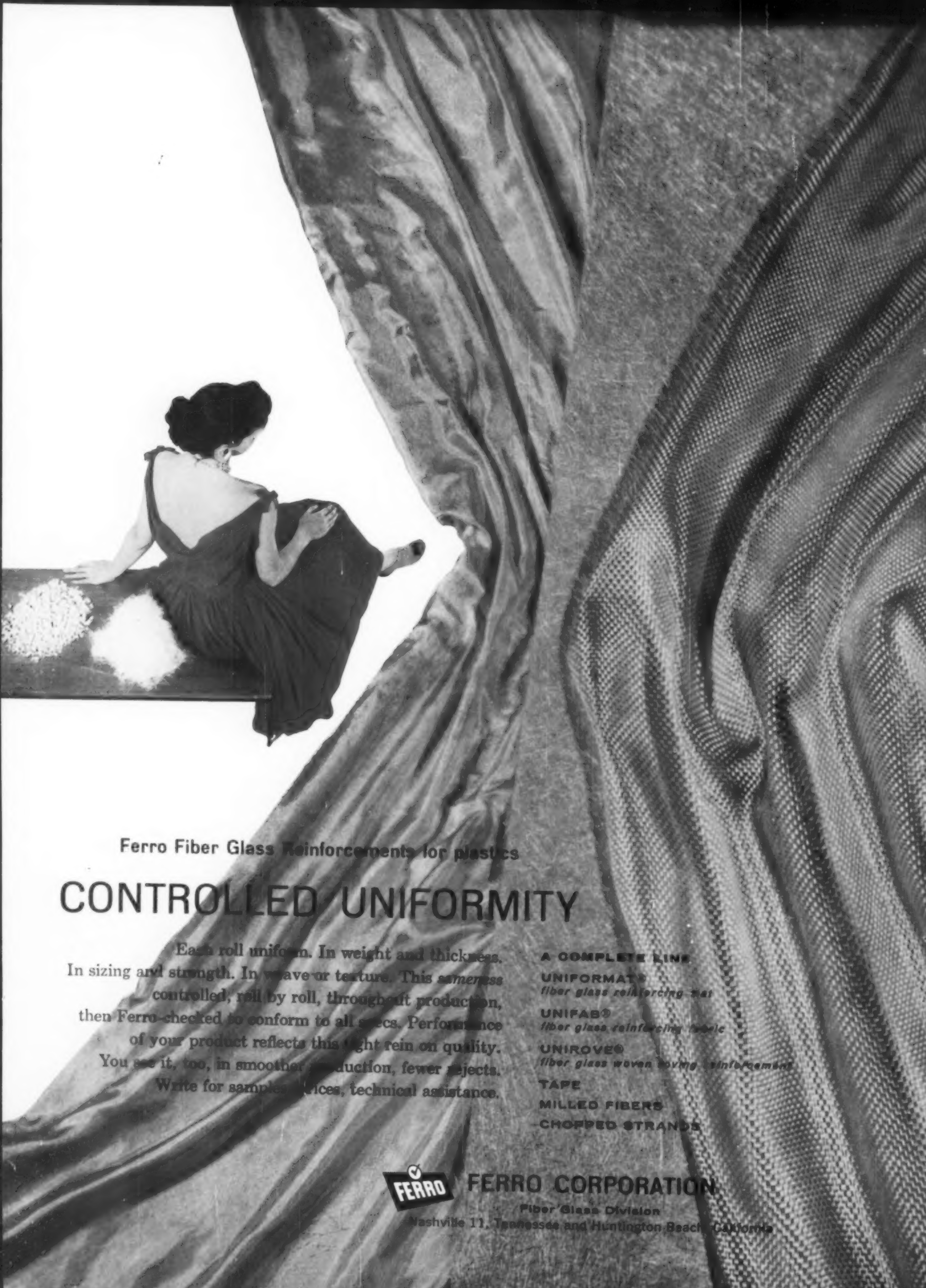

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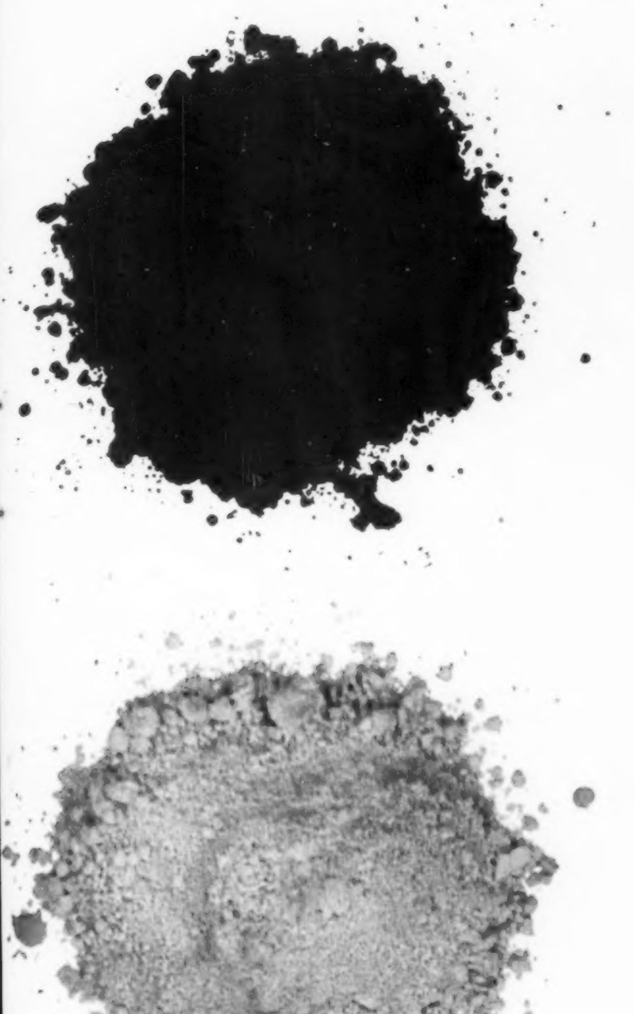

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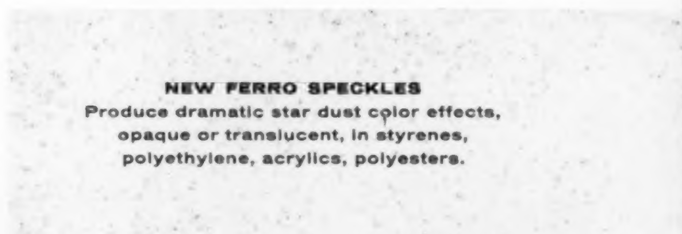

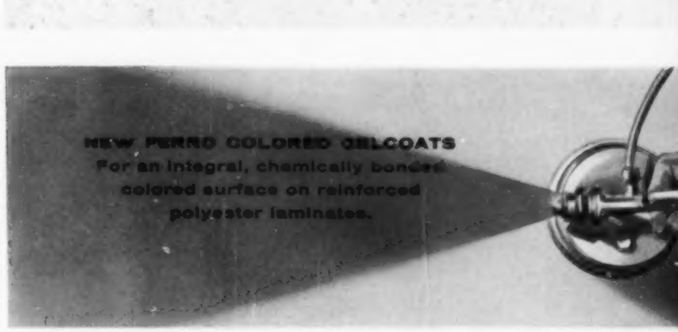

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of Resin C compare quite well with those obtained with Resins A and B, indicating that with methyl Nadic anhydride as a curing agent the chlorine content of the resin is of lesser importance than it is when either TETA or DDS is the curing agent.

It is suspected that the effect of chlorine on the elevated temperature electrical properties might have been even less if a lower concentration of accelerator had been used. With anhydride curing agents that do not require an accelerator it is doubtful if a detectable difference in the elevated temperature electrical properties would be observed, assuming that the HDT values on the cured castings were in the same temperature range. In this series of resins as with each of the previously described series, the high temperature electrical properties obtained with Resin D are quite poor in comparison with the properties that are obtained with Resins A and B.

Conclusions

There appear to be several generalizations that can be made concerning the effect of the residual chlorine in epoxide resins on the physical and electrical properties of the cured resins prepared with various converters. For example, of the properties measured, the physical property most affected by the varying chlorine content resins was the heat distortion temperature. This is undoubtedly a direct result of the decreased cross-linking in the higher chlorine content resins.

However, as illustrated in Fig. 1, p. 159, the effect was more pronounced with some converters than with others. The higher chlorine content resins were more effective in reducing the HDT of the aromatic amine cured resins, whereas the anhydride and aliphatic amine cured resins were affected the least. As pointed out previously, it is suspected that the slope of the curve for the TETA cured resins would be greater if a higher temperature curing schedule had been employed with this series of resins.

It was somewhat surprising to note that the higher chlorine content resins had essentially no

effect on the other physical properties measured such as water absorption, weight loss, flexural strength, and Izod impact strength, although a definite variation was noted from one converter to another. For example, the highest weight loss values were obtained with the DDS series of cured resins, and the lowest weight loss values were obtained with the MNA cured resins. The DDS cured resins also exhibited the highest water absorption values.

The effect of the varying chlorine content resins on the electrical properties was not very apparent at temperatures below the HDT except with the TETA cured resins. Even with the latter curing agent there appeared to be no appreciable effect on either the dielectric strength at 60° C. or the volume resistivity measured at 60° C. after 96 hr. exposure at 95% relative humidity and 60° C. At temperatures above the HDT the different chlorine content resins had a very pronounced effect on the volume resistivity, dissipation factor, and dielectric constant. To a large extent the decrease in electrical properties at temperatures above the HDT was a direct result of the lower HDT of the castings prepared from the higher chlorine content resins.

In an effort to separate the HDT factor from the effect that the chlorine content of the resin has on the elevated temperature electrical properties Fig. 2, p. 159, and 3, p. 159, were prepared. In Fig. 2 the percentage of chlorine is plotted against the volume resistivity values for each resin and converter at a temperature 25° C. above the HDT. The volume resistivity values were obtained by interpolation from a graph plotting the volume resistivity against the temperature for each resin and converter system. In Fig. 3 the percentage of chlorine is plotted against the dissipation factor for each resin and converter at a temperature 25° C. above the HDT for each composition. The data for this graph were also obtained by interpolation from a graph plotting the dissipation factor versus temperature for each resin and converter system. In order to obtain electrical property data at 25° C. above the HDT

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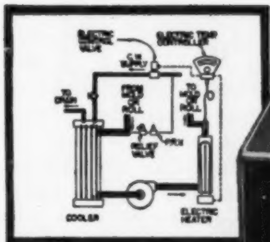

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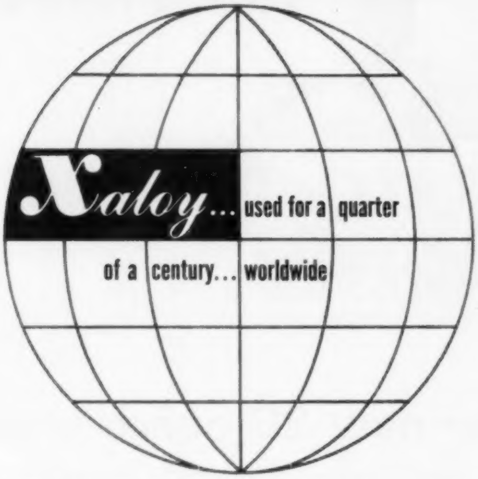
for Resins A and B cured with DDS, it was found necessary to extrapolate the curves.

Although a temperature of 25° C. above the HDT is admittedly arbitrary, Figs. 2 and 3 illustrate quite conclusively that the residual chlorine content of the epoxide resins is more important with some converters than with others. For example, the elevated temperature dissipation factor and volume resistivity values are more dependent on the residual chlorine content of the resins when TETA is the converter than when either MNA or MDA is the converter. The unusual shape of the curve obtained for the TETA cured resins in Fig. 3 is due to the fact that the dissipation factor for Resin C at 130° C. is higher than the value obtained with Resin D. This discrepancy at high dissipation factor values can probably be attributed to experimental error since this property is increasing quite rapidly in a fairly narrow temperature range. The curve obtained by plotting volume resistivity versus percentage of chlorine in Fig. 2 for the DDS cured resins also has an irregular shape resulting from the somewhat higher volume resistivity value at 25° C. above the HDT for the resin containing the highest percent chlorine. Figures 2 and 3 also illustrate that the chlorine content of the resin is not too important a factor in decreasing the electrical properties of either the MNA or the MDA cured resins, and that any decrease in elevated temperature electrical properties noted for these series of resins is a direct result of the lower HDT values obtained with the various resins.

In conclusion it can be stated that any adverse effects that the residual chlorine content of epoxy resins may impart to the cured resins will depend primarily on the chemical structure of the converter used to cure the resin. Of the properties evaluated during the course of this work, those most susceptible to the chlorine content of the resin are 1) heat distortion temperature and 2) dielectric constant, dissipation factor, and volume resistivity values at temperatures above the heat distortion temperature.—**End**



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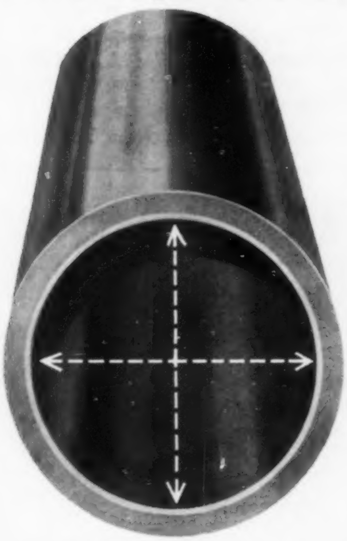

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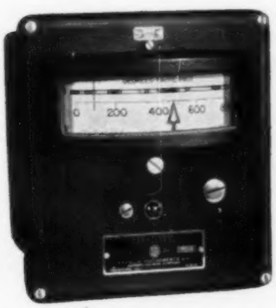

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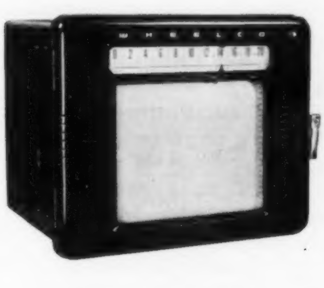

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THE PLASTISCOPE*

News and interpretations of the news — By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 39)* — **November 1959**

The future for plastics—11 billion lb. by '70

The U. S. plastics industry will increase its production 100% over the next 10-year period to reach in 1970 an annual production rate of almost 11 billion lb., according to Paul Mayfield, vice-president and director of Hercules Powder Co., who made these forecasts at an American Chemical Society symposium on "Chemical Marketing in the Competitive Sixties." Most new markets will be new applications, Mr. Mayfield said.

As one example of increased plastics consumption by just one segment of the U. S. economy, he pointed out that the automotive industry in 1958 consumed 100 million lb. of plastics, and in 1965 may use 200 million pounds. The average per car in 1958 is estimated at around 18 lb., in 1965 it may be 32 to 35 pounds. He also pointed out that at Western Electric over 60 million lb. of plastics are used each year, and have replaced steel as the second ranking purchased raw material after copper.

The speaker said that in the next 10 years, plastics will replace, for certain uses, steel, bronze, aluminum, and glass. Other industries which will use increasing amounts of plastics materials are packaging, household appliances, and home construction.

Not only will plastics quality improve in the '60s, but that decade will see continued growth in the happy marriage of plastics and plastics with nonplastics materials. Products have evolved that were never possible with either material, and have opened new avenues of product development.

As to the materials leader, Mr. Mayfield said that polyethylene will soon be the first billion-lb. plastic, and by 1965 polypropylene will be approaching billion-lb. production also.

The accompanying tables, used in the talk, illustrate some aspects of the growth of plastics.

Table I: Plastics production in billion pounds[a]

Year	*Production*
1958	4,660
1959	5,170
1960	5,600
1965	8,000
1970	10,900

[a] Taken from U. S. Tariff Commission data for 1958 and projected by Hercules Powder Co. for the other years.

Table II: Per capita consumption of plastics in the United States

Year	*Pounds per person*
1934	¾
1950	15
1955	23½
1957	26
1960	31
1965	41
1970	51½

Note: Population forecasts range from 174 million in 1958 to 211 million in 1970.

New stabilizer for plastics

The use of Voidox 100% as a stabilizer for polyolefin and polyvinyl plastics has been announced by Guardian Chemical Corp., Long Island City, N. Y.

Originally introduced as a food-grade antioxidant, Voidox 100% added in percentages from ½ to 1% improves both the light and oxidation resistance of these plastics and, improves their flexibility in heavy sections, according to a company spokesman.

Voidox 100% is a white, waxy, fatty-acid modified derivative of a substituted phenol. Because of its extremely low toxicity and acceptability for use in many types of foods, the addition of Voidox 100% can be employed as a modifier of plastics which are to be used for the manufacture of food containers, says the company literature. The low color factor as well as low melting point enable Voidox 100% to be incorporated in many of the thermoplastics.

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Polyethylene contour coating

Plastic Papers Inc., 210 Miller Rd., Hicksville, N. Y., is now shipping paper, board, and foil coated with polyethylene by a special technique. The process, not to be confused with hot-melt coatings, involves an elastic film, easily heat-sealed, crease-resistant, that is claimed to possess all polyethylene barrier characteristics.

Plastic Papers' process, known as contour coating, consists of dissolving polyethylene in a solvent, then flowing the homogeneous solution uniformly on to the substrate material. The solvent is then completely removed, the polyethylene remaining as a uniform, continuous film on the backing.

According to Kenneth J. Rawson, general sales manager, a number of important advantages result from this process:

1. Absence of pin holes. Inasmuch as there is no stretching of what frequently is a gossamer-thin film as in extrusion lamination, there is no film rupture resulting in pin holes.

2. Cleanliness. Coating with a liquid solution permits easy cleaning of dust and factory additives which are difficult to remove from the pellet form of resin that is used by extruders.

3. Superior bond. Because contour coating flows the polyethylene on to the backing paper, there is no bridging or delamination.

4. Uniform barrier qualities. Gage of paper varies, resulting in high and low spots. With hot-melt, "lows" receive a (To page 216)

News about R&A SINCE 1912

Adhesives

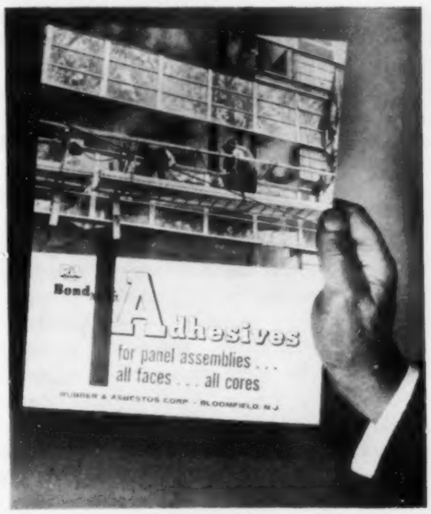
FOR ALL METALS AND ALL PLASTICS

New, easy-to-spray "panel" adhesives speed drying, cut costs . . .

- ***Yield high strength bonds in all types of panels***
- ***Permit swift, sturdy bonding at room temperature***
- ***Feature outstanding heat and water resistance***

New R&A "sandwich" panel adhesives – such as BONDMASTER G580 – combine faster drying speed with improved spraying characteristics. As a result, you not only enjoy much faster and smoother area-coverage-per-gallon but cut assembly-time costs substantially.

Other new adhesives, (BONDMASTER G592, for example) were formulated to bond at room temperature and can be combined virtually instantaneously. Nevertheless, they still incorporate the easy spray-ability that makes them ideally suited for desk-top work and similar applications where both good strength and flexibility are the targets.



Profusely illustrated, 16 pp. Brochure #135 describes adhesives and production methods used in manufacture of curtain wall and other panel assemblies consisting of a variety of cores and faces. Contains test data and details of mass production bonding techniques. Send for your free copy today.

WHERE ASSEMBLY IS DELAYED

For specialized panel assemblies where maximum flexibility and longer "open time" are the key requirements, products like BONDMASTER G544 may be combined for room temperature bonding as long as 6 hours after spraying (or as soon as 10 minutes afterward if speed of assembly is essential).

HOT OR COLD BONDING OF ALL FACES, ALL CORES

There are almost as many different ways to bond "sandwiches" as there are types of assemblies . . . and end-uses.

Generally speaking, the type of equipment available, the end-use service conditions, and the price limitations of the completed panel determine the choice of adhesive.

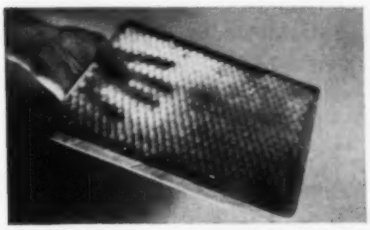
Since we manufacture formulations for the bonding of just about every type of panel produced today (paper, wood, plastic, or metal cores and/or faces) we're in an exceptional position to help you solve *your* specific adhesives problems.

Write for technical data on the full range of BONDMASTER "sandwich panel" adhesives. Better still, send for our detailed Problem Analysis Form so that you can outline your problem fully for our best and most current recommendations.

Where solvents are "taboo" . . .

Frequently, certain panel components . . . or the end-use service conditions . . . or your available manufacturing facilities . . . demand the use of 100% reactive adhesives.

For example, where one surface is a relatively soluble thermoplastic (such as polystyrene in rigid sheet or foamed form) there is often a need for a solvent-free adhesive that can provide sturdy bonds without heat or pressure. This is particularly true where a greater degree of structural load-bearing is involved ("specialty" canopies, skylights, etc.).



Similarly, a special approach is called for when the bond is expected to withstand unusual temperature extremes (such as the 250°F and over in some military structures) or where resistance to acids, strong alkalies, solvents, etc., is needed.

For such specialized applications, it will pay you to investigate R&A's 100% reactive, solvent-free BONDMASTER epoxies and PLYMASTER dry film adhesives. Detailed technical data upon request.

R&A SINCE 1912

RUBBER & ASBESTOS CORPORATION

243 BELLEVILLE AVENUE
BLOOMFIELD, NEW JERSEY

(From page 214)

heavier application of polyethylene than "highs" resulting in uneven barrier characteristics. Contour coating (as the term implies) actually follows the surface configuration of the sheet, covering both highs and lows equally so that barrier properties are uniform.

5. Crease resistance. Since the coating is a stretchable film (as contrasted with hot-melt) there is no cracking of the coating when creased or folded.

6. Elimination of overweight coatings. Frequently, light coatings applied by the extrusion lamination process are run overweight in order to reduce pin holes and breaks in the film. Contour coating may allow a reduction of coating weight without any sacrifice in barrier qualities. This reduction of coating weight (and cost) may allow polyethylene to replace such barrier materials as asphalt and wax at little or no increase in cost.

Foster Grant files registration statement

Foster Grant Co. Inc. has filed with the Securities and Exchange Commission a registration statement covering the proposed public sale of 190,000 shares of common stock. The sale would be the first public sale of stock of the company, which has been closely held. Of these shares, 100,000 are being issued by the company to provide funds for its construction program, and 90,000 shares are being sold by a group of stockholders.

The company, which began operations in 1919, now produces polystyrene and styrene monomer, manufactures a variety of molded plastic articles, and manufactures nylon molding and extrusion powders. Plants are in Leominster, Mass.; Manchester, N. H.; and Baton Rouge, La.

PVAc film for laminates

A deglossed decorative laminate that requires no brushing to achieve a low-reflective, satin finish has been developed by Swedlow Inc., Youngstown, Ohio, with the assistance of Reynolds Metals Co. A matte-finish polyvinyl alcohol casting film is used to obtain the appearance of natural wood that has been sanded, filled, stained, shellacked, and buffed.

The new product is designated Kevinite #27 Furniture Finish. It is said to resist boiling liquids, grease, and solvents.

Plants for foam panels

Production of sandwich panels for home construction with a core of Koppers' Dylite polystyrene foam will start in the near future on the West Coast. Koppers Co. has licensed Nels G. Severin, immediate past president of the National Association of Home Builders, and Daniel B. Grady—executives of Severin Construction Co., San Diego, Calif.—to produce and distribute the panels and will make available its production technique and supply technical assistance.

Mr. Severin formed a new company, called Dyacor Products Inc., which will locate in Los Angeles, and start production early in 1960. Initially, enough panels will be produced to build 1200 homes per year, but space will allow stepping up production for 4700 homes annually. A similar plant of the same capacity will be equipped in San Francisco, and Dyacor is considering further plants in Phoenix, Ariz., and in the Hawaiian Islands.

A demonstration home in the $30,000 price range using the new panels will be erected in La Mesa, Calif. Mr. Severin anticipates that by 1960, development work will reach the stage where the panels can be used in all price homes.

New views on embedding

A composition made of microscopic phenolic balloons bound together by an epoxy resin and used to embed and protect instruments and other electronic equipment against vibration, heat, humidity, salt spray, and fungus was recently compared with an embedding system using urethane foam.

F. T. Parr, materials and process engineer of the Westinghouse Electric Corp., in a paper presented at the 136th national meeting of the American Chemical Society, stated that the use of the Microballoons saves about 27% in weight over conventional filler materials.

Phenolic Microballoons are microscopic bubbles about the size of a pin point, filled with an inert gas such as nitrogen. They were originally developed to retard evaporation losses on oil storage.

A chemical foaming urethane resin brings about a 51% reduction in weight. However, it has the disadvantage of being a much poorer heat conductor than the epoxy resin system, Mr. Parr stated. Circuits containing heat generating components such as tubes and resistors would fail much more frequently if embedded in foam, unless special heat sinks were used to carry off excess heat.

According to Mr. Parr, the greatest advantages to be gained by usng the low density Microballoons are weight reduction over the conventional filler systems and less tendency toward cracking of the resin during temperature cycling. They are superior to the urethane foams because they are more resistant chemically, and have much better electrical properties after exposure to environmental tests, particularly humidity.

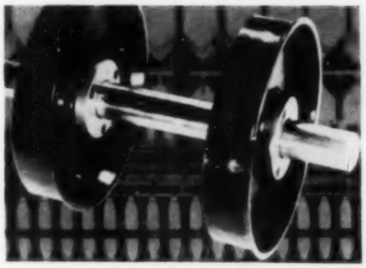
Experimental calender

Farrel- Birmingham Co. Inc., Ansonia, Conn., has recently installed in its process laboratory for customer use, a new 8- by 16-in., four-roll, inclined "Z" calender. Its design includes individual, direct-current drives for each of the four rolls, with stepless variation in roll speeds from 6 to 48 ft./min. and any required friction ratio for any roll pair. These features and an operating temperature range up to 500° F., make this machine suitable for experimental calendering work on unsupported film and double film or sheeting; single and double coat on carrier; and single frictioning. Also available is a take-off unit with cooling or heating, idler rolls, letoffs and a variable-speed, motor-driven windup.

Within a booking schedule which allows for confidential experimentation, the use of all facilities of the laboratory are available without charge up to two days a year for evaluation of new materials and processes. **(To page 218)**

PRODUCT-DESIGN BRIEFS FROM DUREZ

- **impact strength comes down in price**
- **fast-curing phenolic cures a cost problem**
- **new idea for closures**



High impact at low cost

These big pulleys help drive huge spinning frames made by Roberts Co., Sanford, N. C., a leading manufacturer of textile machinery.

Until recently, the pulleys were made of stamped metal or heavy cast iron. Designers looked for a better material—strong, dimensionally stable, low in cost. They found it in *Durez 18683.*

This new sisal-filled phenolic solves the cost problem of high-impact parts in three ways:

1. It costs only pennies more than general-purpose wood-flour-filled phenolics.
2. It molds by simple compression or transfer methods, using standard presses, standard pressures, standard dies.
3. It cures as fast as general-purpose compounds.

Durez 18683 molds dimensionally stable parts with impact strength of 1.4 ft. lb./in. Molded parts are self-extinguishing, have excellent resistance to humidity, and can meet U/L requirements for attached electrical contacts. You'll find that *18683* opens the way to savings on hundreds of applications where higher-cost materials are used now.

Consider it for heater and air-conditioner housings, instrument panels. Specify it for gears, wheels, pulleys, electric motor end bells—wherever you need impact strength and want it at lower cost.

The sooner you investigate *Durez 18683,* the sooner you can start saving with it! For bulletin, data sheet and/or evaluation sample, mail the coupon today.

Torrid tempo

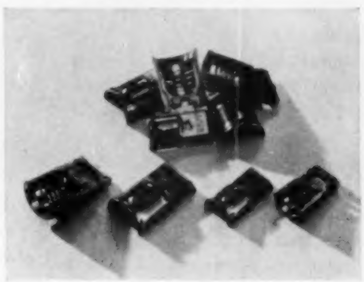
Rapid production is beating out a new rhythm of lowered costs for the makers of these small lamp sockets (center column), Noma Lites, Inc.

The key notes are smart redesign, use of multi-cavity molds, and an exceptionally fast-curing Durez phenolic.

Formerly, the manufacturer bought one-piece sockets, forced metal screw shells into them, applied pitch to protect against moisture, then laboriously soldered in the wires.

Zip! Now, threads are molded into the split sockets by the molder, Holyoke Plastics Company Inc. Wires are laid across the socket halves. A simple metal clip joins the halves and pierces the wires with contacts.

Whoosh! Socket halves are molded 80 at a time. Into the molds goes speedy *Durez 265,* general-purpose compound that cures in a few seconds. Even at this dizzy rate, its batch-to-batch uniformity assures consistent molding.



Hurry! Want to snap things up a bit? *Durez 265* can probably help you do it. To see how, dash right over to your molders. Or shoot us coupon for data on *265* and other GP molding compounds.

A cap can be pretty

Not so long ago, you couldn't get this decorative effect in a molded plastic closure. Now you can.

It's done by wiping color into the debossed design. Debossing used to be the crux of the problem, because of the undercuts. It was impossible to make a workable mold cavity by machining, hobbing, or casting.

The solution: electroforming. The mold is built up in nickel around a soft, resilient master, which is then withdrawn from the cavity.

The process is a development of Armstrong Cork Company and Electromold Corporation. It gives the designer a new freedom—permits intricate textured effects like leather and wood grain, as well as the simpler ones you see here.

Durez is in the picture, too. Versatile phenolics, especially formulated for bottle and container caps, provide the requisite impact strength, resist chipping and cracking, and do not bleed when in contact with alcohol. If these qualities might help you uncork a closure idea or unbottle a bottleneck, we suggest you contact your molder on the use of Durez phenolics for closures.

For more information on Durez materials mentioned above, check here:

- ☐ High-impact low-cost phenolic, *Durez 18683* Bulletin and data sheet
- ☐ Evaluation sample of *Durez 18683*
- ☐ *Durez 265* (data sheet) and descriptive Bulletin 400

Clip and mail to us with your name, title, company address. *(When requesting samples, please use business letterhead.)*

DUREZ PLASTICS DIVISION

12011 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICAL CORPORATION

HOOKER CHEMICALS PLASTICS

THE PLASTISCOPE

(*From page 216*)

Arrangements can also be made for more extended periods of use on a fee basis.

Acrylic enamel

A new lustrous acrylic-enamel-on-aluminum finish for mobile home exterior panels has been introduced by Reynolds Metals Co.

The Du Pont-developed Lucite acrylic baked enamel will be offered as part of the Reynolds Colorweld line of mobile home sheet, in coiled or flat form. It is available in six popular colors at no increase in price over regular finishes.

This new enamel is said to be the first Lucite acrylic ever roller coated on strip for subsequent forming. It is virtually non-chalking and retains high gloss and durability to a degree unobtainable in any other coating, according to Reynolds.

Plasticizer for packaging film

Reichhold Chemicals Inc. has announced that the Food & Drug Administration has sanctioned the use of Peroxidol 780 as a plasticizer-stabilizer in food packaging materials. Peroxidol 780 is used in vinyl packaging films to impart resistance to the damaging effects of both heat and light, as well as plasticizing the film. It may also be used in lacquers and other materials for can and container linings.

The FDA sanction covers the use of as much as 35% of Peroxidol 780 in food packaging materials, which is up to seven times more than is generally required to obtain the desired properties, according to the producer.

Polystyrene foam insulation

Pipe covering made of Uni-Crest expanded polystyrene for a wide range of design conditions is available from United Cork Companies, Kearny, N. J.

The material, which is widely used in slab and block form for a variety of low-temperature insulating requirements in the residential and commercial building fields, is said to stop effectively costly heat gain, and prevent condensation and dripping. It is odorless and nontoxic, will resist moisture, and has a compression strength of 16 to 20 p.s.i.

Uni-Crest pipe covering is available in three standard sizes, in both regular and self-extinguishing types. Light duty—nominal 1-in. for temperatures above freezing; Medium duty—nominal 1½-in. for temperatures of 32° F. and Heavy duty—nominal 2-in. for temperatures of 0 F. to −30° F. Extra thicknesses are available for more severe conditions.

RP panels defy explosion

Translucent fibrous-glass reinforced panels made with Hetron polyester resin successfully withstood a severe explosion at Hooker Chemical Corp.'s Niagara Falls, N. Y. plant.

When the explosion occurred, the panels either flexed and sprang back to position, or were forced loose from the bolts securing them and dropped to the ground as intact panels. Because they are shatter-proof and there were no sharp cutting edges to cause injury, danger was greatly reduced.

The corrugated panels, tradenamed Fire-Snuf, were made by Resolite Corp., Zelienople, Pa.

Plastics grow as wire insulation

Despite the many recent advances in the art and science of communications, the simple insulated wire is still the work horse of the field, and the use of plastics, particularly colored plastics, in this application has greatly expanded in recent years.

According to *Bell Laboratories Record*, in 1950 the Bell System used 33 million lb. of various materials for covering and protecting cable. Consumption was about equally divided among plastics, rubbers, and textiles. In 1956, Bell used nearly 75 million lb. of insulating and sheathing materials. By this time plastics had increased to over 50% of the total—mainly at the expense of rubbers. Polyethylene and PVC accounted for the major increase, jumping to about 40 million pounds. This expansion has been made possible by the development of colors, protective plasticizers, and techniques to provide long life and non-fading insulating materials.

Fabricon to make PE film

Installation of new production equipment for the manufacture of polyethylene film has been announced by Fabricon Products, a division of the Eagle-Picher Co., River Rouge, Mich.

The new film has been introduced under the name Fab-Wrap, and is manufactured by the chill roll extrusion process. In addition to the current installation, plans call for a second Fab-Wrap production line to be in operation before the end of the year. Emphasis will be placed on producing grades of film suitable for overwrapping retail products. Both plain and printed Fab-Wrap film are available, the company states.

PE as pool screening

Outdoor swimming pools can now be converted into year 'round recreation centers by installing a Solaroof, developed by International Swimming Pool Corp., White Plains, N. Y. Constructed of heavy duty aluminum extrusions and several layers of polyethylene and saran screening, the covering is said to have performed well under the equivalent of heavy snow and extreme low temperatures.

The specially designed translucent PE and saran sheets, while affording a maximum of privacy, allow the beneficial rays of the sun to enter the enclosed pool area. Installation of the roof itself, weatherproofed sides, and doors requires from 2 to 4 days.

Vinyl like silk

An elastic vinyl upholstery material with the sheen of silk and rugged enough to withstand the abuse given to furniture in offices, hotels, banks, and other commercial establishments is now being marketed by Columbus Coated Fabrics Corp., Columbus, Ohio, under the tradename of Milano. The vinyl face of the new laminate material is based on Goodyear's Pliovic. The compound is calendered and then laminated to an elastic fabric **(To page 220)**

Uses CYCOLAC®

THE TOUGH, HARD ABS PLASTIC
***from* BORG-WARNER**

New Compactness, Modern Functional Design, Built-In Versatility...

are the features of the new 18- or 30-button Call Director. Simply push a button for regular telephone service, plus interoffice calls, multi-line pickup, conference calls, signalling and other special requirements.

CYCOLAC was specified for housing and handset by Western Electric because of its excellent qualities of rigidity and rugged toughness. The handsome colors add much to the decor of today's modern office—the hard, stain-resistant surface makes it possible to maintain this appearance. CYCOLAC provides maximum serviceability yet affords important economies in production.

For these reasons, CYCOLAC ABS plastic is playing an ever more important role in the design of new products for modern business and industry.

CYCOLAC...*better in more ways than any other plastic!*

PACESETTER IN
Marbon CHEMICAL
SYNTHETIC RESINS

Division of BORG-WARNER • Washington, W. Va.

also represented by:
WEST COAST: Harwick Standard Chemical Co., Los Angeles, Cal.
CANADA: Dillons Chemical Co. Ltd., Montreal & Toronto
EXPORT: British Anchor Chemical Corp., New York

THE PLASTISCOPE

(From page 218)

backing. The material derives its silklike shimmer through use of special embossing rolls and through light reflecting pigments incorporated in the sheeting.

New concept for buildings

Three new "instant factories" in the form of air-supported structures will house the Balloon and Polyester Divs. of G. T. Schjeldahl Co., Northfield, Minn.

The project, to be completed within a month, will include two air-supported structures, each 240 ft. long and 40 ft. wide, made of reinforced polyester materials and called Schjeldomes.

Total cost of the installation will be about $3/sq. ft. of area covered, with buildings heated, lighted, and ready to operate—which is said to be less than a third of the normal cost for permanent-type factory structures. The plastic skin of the buildings has an estimated life of from 5 to 10 years, according to the company. (See also "Where airhouses pay off," which appears on p. 115 of this issue.)

New acrylate

Commercial production of 2-ethylhexyl acrylate has been started by Celanese Chemical Co. at its recently expanded Pampa, Texas plant. The new product is an addition to the company's line of acrylate and butyl acrylate.

All these acrylate monomers are used in the manufacture of polymers for the paint, textile, and paper coatings and adhesives fields.

For slush molding

A plastisol for rotational and slush molding, and for hot dip coating of metal parts has been developed by Dennis Chemical Co., St. Louis, Mo. Designated Plastisol No. 9218, the material is said to have excellent dimensional stability, low lacquer mar, high tensile strength, good dielectric properties, and high impact.

Foam with wood texture

Special techniques developed by The Dow Chemical Co. can impart a swirled texture like wood grain to items molded from the company's Pelaspan **(To page 222)**

Your Modern Plastics Encyclopedia Issue contains 1,242 pages of answers to questions like these:

"In *designing* plastic products, what factors govern the choice of surface decoration? What materials should be selected to meet specific impact strength requirements? What fastening devices or adhesives are available to most economically handle assembly problems?"

"How do you set up a *cost estimate* for custom injection molding work? How do you set one up for compression and transfer molding?"

"What were the noteworthy developments revealed at the First International Plastics Exhibition and Convention in London?"

"Why are epoxy resins especially recommended in *casting compositions* for use in encapsulation and potting of electrical and electronic components?"

"How are the styrene blends affected by strong acids?"

"What markets have opened up for *vinyl plastisol* materials?"

"What *special techniques* and formulations have been developed for the foaming of reaction-type phenolic resins?"

"What *printing method* is most commonly used in producing printed packaging films? And why is there a swing toward this process among decorators of light-gauge polyethylene?"

"In reinforced plastics, what are the pros and cons of *matched-metal die molding?*"

"Where can you purchase electronic heat sealing machines?"

"Who are some custom molders and extruders around Detroit?"

What's <u>your</u> question?

THE PLASTISCOPE

(From page 220)

polystyrene beads. The new texture, called Frost Wood, can be achieved in many different shapes, forms, and colors.

Wall coverings, appliances, housewares, thermo-walled ware, and decorative packaging are some of the fields that offer promise for textured polystyrene foam. One of the first applications is a gift package for golf balls that also makes an attractive ice bucket or humidor.

Vinyl for shoe industry

A new type of vinyl strap stripping for the shoe and leather industry has been announced by The Borden Chemical Co. Called Perma-Seal, it is said to withstand temperatures ranging from −50 to 150° F. In addition, the strap material is claimed to have passed the 100,000-plus flex test and the 85-lb. pull strength test.

Perma-Seal strapping is said to be crease and distortion resistant. It can be obtained from stock in high gloss patent leather or calf finishes, and in ¼-, 5/16-, and ⅜-in. widths.

Lower price for TMP

A reduction of 4¢/lb. for trimethylolpropane, bringing the truckload delivered price down to 35¢/lb., has been announced by Celanese Corp. of America. Trimethylolpropane, an intermediate for urethane and alkyds, is produced at the Bishop, Texas plant of Celanese.

Texas plastics group

A statewide steering committee is studying an organization of Texas plastics manufacturers and distributors for promoting the industry in that state. Melvin Hare, president of Lone Star Plastics Co. Inc., has been elected chairman of the new committee.

The organization is planning to promote public acceptance and understanding of the various facets of the industry; bring the industry closer together; provide educational programs for the various colleges and universities in regard to plastics engineering; acquaint other industries with benefits which the **(To page 224)**

THE PLASTISCOPE

(*From page 222*)

field of plastics has to offer; and develop training programs for plastics workers.

A prospectus will be available from Lone Star Plastics Co. Inc., 124 Roberts Cut-Off Rd., Fort Worth, Texas.

Approved for food uses

Plastics products which may come in contact with food may contain Slip-Eze, an anti-static agent manufactured by Fine Organics Inc., Lodi, N. J., according to the company. The additive for PE, polystyrene, polypropylene, and other plastics materials, qualifies for exemption under the newly-amended Food, Drug & Cosmetic Act, the producer claims.

The material, in the form of powder or pellets, is incorporated into the plastics material before extrusion or molding, and imparts a gloss to the plastics surface.

Enters blow molding field

The organization of a blow molding department that is equipped to produce pieces up to 2-qt. sizes has been announced by Nosco Plastics Inc., Erie, Pa. The department is organized to use any extruded plastics material.

Low-temperature plasticizers

The use of phosphorous-containing compounds made from inedible animal fats as new plasticizers was discussed by scientists of the U. S. Department of Agriculture's Research Service, at the recent national meeting of the American Chemical Society.

The plasticizers are dialkylphosphonostearates which, when added to PVC to the extent of about 35% by weight, are said to keep the material soft and flexible even when exposed to temperatures to —50° F. They also reportedly migrate from the plastics material at a much slower rate than any other known low-temperature plasticizer, thus increasing the flexibility-life of the plastic end-product.

New green pigment

A bright green pigment with a distinct yellow hue, and with properties similar **(To page 226)**

HOW TO COMPARE PLASTICS PROPERTIES AT A GLANCE

SELECTING THE BEST PLASTIC compound for a specific requirement is much easier when you can compare properties and working characteristics at a glance—as you can on the Plastics Properties Charts provided with the MODERN PLASTICS ENCYCLOPEDIA ISSUE.

You can obtain sets of these charts separately, in whatever quantity you need. A set consists of two charts, each 17½ x 44½ inches, one listing 46 thermoplastics and the other 46 thermosets. Each covers molding and extrusion compounds, cast resins and sheet, rod and tube stock.

You can compare the compounds in any of 42 physical, chemical, electrical, heat resistance and molding characteristics simply by reading across the chart, aided by special color coding. Trade names and manufacturers' names and addresses are given for each type of plastic.

How many walls in your offices and shop need Plastics Properties Charts, to make accurate selections certain and easy? See the price schedule for the negligible cost of the number you need, and write Reprint Dept., Industrial Magazine Service, (an affiliate of Breskin Publications) 575 Madison Ave., New York 22, N.Y.

PRICE SCHEDULE

In quantities of:

1 to 5	**$1.00 per set**
6 to 49	**.75 per set**
50 to 100	**.50 per set**

Bulk rates on request

THE PLASTISCOPE

(From page 224)

to those of phthalocyanine green, has been developed by the Dyestuff & Chemical Div. of General Aniline & Film Corp.

Designated Heliogen Viridine Y, it may be used where phthalocyanine green has been found satisfactory, including the pigmentation of polystyrene, all vinyl plastics, PE, melamine, acrylic, urea, and epoxies, the company states. The new pigment is said to be stable in polyester resins. A 500-hr. sunlamp exposure test reportedly caused no fading of polyester castings pigmented with the new product and catalyzed with 1% benzoyl peroxide.

Ink for PE

A new marking and decorating ink, designated Rubbagrip, which can be used on treated or untreated PE, has been developed by Rubba Inc., 1015 E. 173rd St., New York, N. Y. The ink is said to remain permanently flexible and does not chip when flexed. It is also suitable for marking or decorating other plastics where flexibility is of importance.

PE paper coating resins

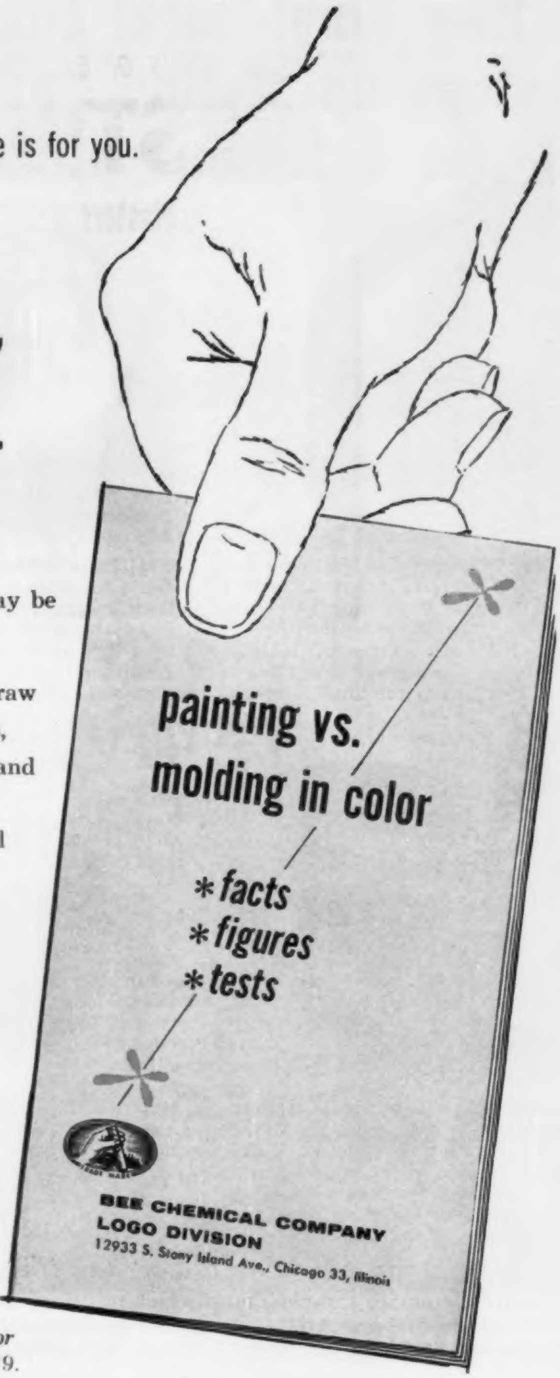
Three new polyethylene paper coating resins, which are said to display a marked improvement in adhesion and draw-down characteristics as well as a reduction in neck-in, smoking, coating temperatures and polymer build-up at the die, have been developed by U. S. Industrial Chemicals Co. The new resins, which have been field tested and are now commercially available, are designated Petrothene 200-2, 201-2, and 203-2 and have a melt index of 3.0, 5.0, and 8.0, respectively.

These PE resins have been extruded onto a variety of substrates, including paper, paperboard, foil, cellophane, and others.

According to U. S. I.'s Vincent McCarthy, Director of Plastics Sales, there has been a fast rise in the use of polyethylene coated substrates by the packaging industry during the past few years. Coated paper, cellophane, and foil food pouches, food board for applications such as bakery boxes, and increased **(To page 228)**

If you buy special-color plastic parts, this message is for you.

This new production "tool" can cut your part costs...



If you buy special-color plastic parts, you may be paying more for them than necessary . . .

If your requirements for each special-color raw stock are below maximum-discount quantities, your parts will probably cost less painted (and molded from neutral or reprocessed material) than molded in color. And Bee Coatings equal or better finished part appearance and performance. Color selection—including metallics—is unlimited, offers numerous advantages in addition to low cost.

Painting is a useful production "tool"—not a cure-all. There are cases where painting pays, and others where molding in color is still best. Where pennies count it's wise to figure *every* part both ways—painted *and* molded in color.

Detailed information, including actual costs and other advantages, is yours for the asking. Write now for Bulletin E119.

TRADE MARK

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LOGO DIVISION
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17000 S. Western Ave.
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Visit our Hospitality Suite Conrad Hilton National S. P. E. Technical Meeting 12-15 January • Chicago

THE PLASTISCOPE

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usage of poly-coated kraft in multi-wall bags and as an industrial barrier material have accounted for most of the growth so far. By 1964 the industry should be using about 95 million lb. of PE annually for coated packages. One large field, polyethylene coated milk cartons, is still in its infancy. If this market opens up in the near future, the figure for polyethylene usage could easily exceed 100 million lb. per year by 1964, said Mr. McCarthy.

For high temperature uses

A reinforced phenolic laminate for missiles and aircraft, designed as a low-dielectric, structurally strong material in the 1000° F. range, is available from Riverside Plastics Corp., Hicksville, N. Y. Designated TRC-X, the new material is said to retain good structural properties even when exposed to high temperatures and instantaneous thermal shock.

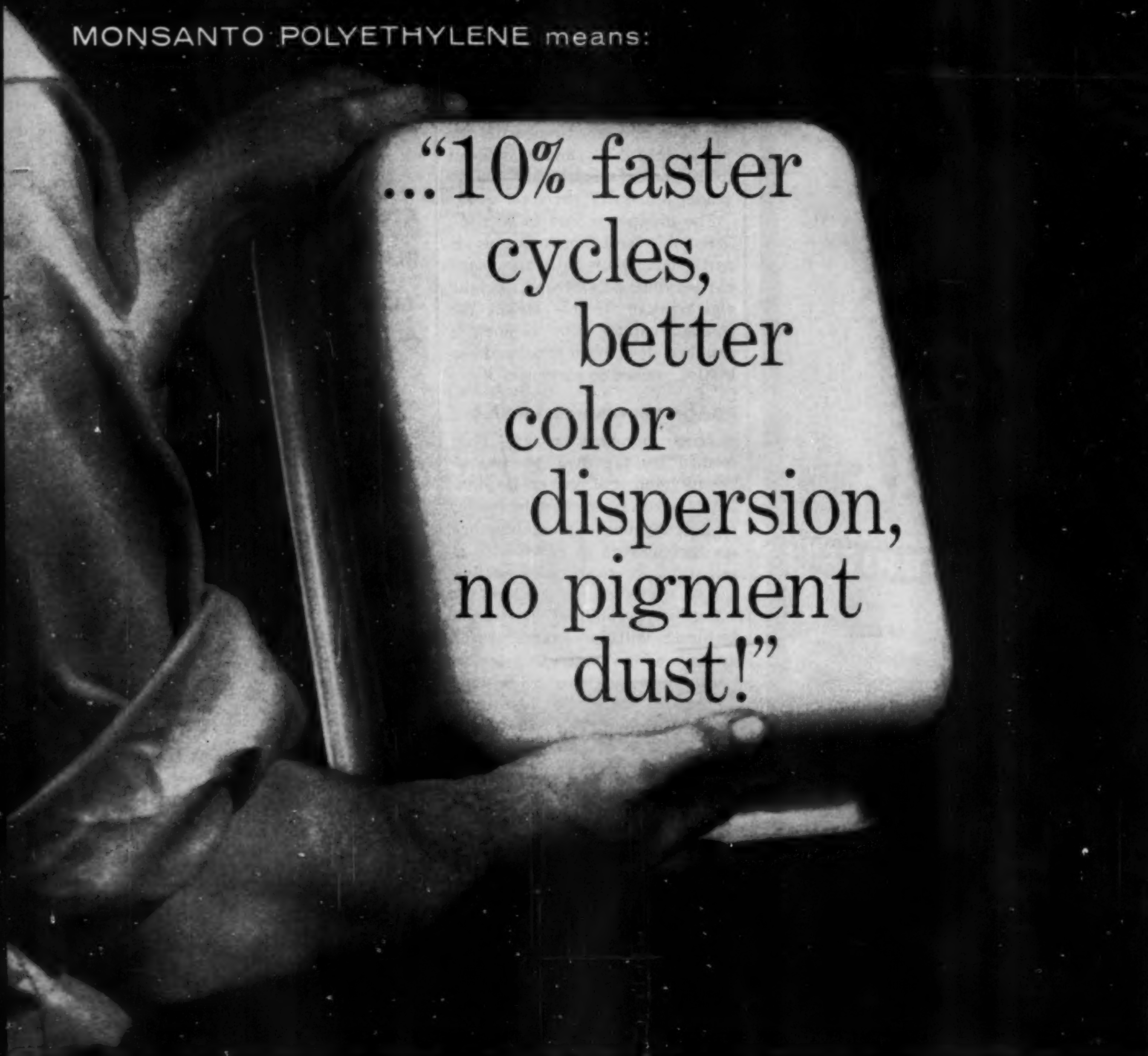
It can also be used as a heat insulating barrier. When bonded to aluminum, for example, the low thermal conductivity of the laminate is said to prevent high skin friction temperatures from annealing the metal underbody.

Movies on urethane foam

Two of the leading suppliers of isocyanates—Allied Chemical Co. and Mobay Chemical Co.—have produced color movies to provide greater understanding of urethane foams. Allied Chemical's film, called "New Dimensions in Comfort," highlights the extensive chemical research, the variety of tests and experiments, and the controls necessary to produce quality urethane foam cushions. Mobay's "Foamagic for Homemakers" places its main emphasis on the design possibilities with those foams and is directed towards wider consumer education. Both companies have already made arrangements for TV showings on local stations throughout the country.

Cleans plastics panels

A new liquid cleaner and polishing agent for transparent panels, windows and **(To page 230)**



Plastic Engineering Inc., Cleveland, Ohio, reporting:

"The bag-to-bag, blend-to-blend, big batch uniformity of Monsanto Polyethylene 9752 enabled us to slice 2 seconds per part off our cycle time. With dishpan production in the thousands, this reduction is appreciable.

"In addition, we can now maintain uniform color throughout an entire run—a definite sales-plus. Before switching to Monsanto Polyethylene, pigmented material dust, during dry coloring, was a serious problem. During press runs, dust would escape and literally cover everything in the area. To keep foreign elements from getting in a batch and streaking the products, we had to wash down the presses between runs. It even became a morale problem, which our change to Monsanto Polyethylene has happily solved.

"One last, but not least, factor is the convenience of disposable palletized shipments. It has reduced unloading and stacking time from 3 men in 2 hours to one man in a lift truck for a half hour."

The complete line of Monsanto Polyethylene Molding Resins is described in detail in our new composite data sheet. Write for a free copy of this folder to Monsanto Chemical Company, Plastics Division, Room 964 Springfield 2, Massachusetts.

Monsanto

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windshields on boats, automobiles, aircraft, and television sets is offered by Schwartz Chemical Co. Inc., Long Island City, N. Y.

Called Rez-N-Polish, the cleaner has been developed especially for removal of haze and cloudiness from plastic windshields and to render anti-static surfaces.

The product is said to be non-flammable and non-toxic. It is particularly well-suited for cleaning acrylics, polystyrene, acetate, and rigid or flexible vinyls, the company states. The cleaner is supplied directly in 8-oz. squeeze bottles, packed in cartons of 36.

Plastic Housewares Institute

A new organization has been formed for the dual purpose of encouraging the public to buy better made plastic products and to protect materials manufacturers and plastics in general. It is called the Plastic Housewares Institute, and is located in Akron.

Products submitted by manufacturers will be examined for quality, design, and value and if requirements are met, will be permitted to carry the institute's label of approval. This label, along with a plastic education program, will be advertised in national magazines and on television.

The institute is planning a building to house its test laboratories and advertising offices.

Further information can be obtained from E. A. Greene, director, Box 6015, Akron 12, Ohio.

Urea light panels

Louver diffuser panels, which are said to be non-combustible, are now compression-molded from Allied Chemical's Plaskon UFR-28 urea resin by Edwin F. Guth Co., St. Louis, Mo.

According to Guth, the 24-in. lighting panels, called NC Gratelites, are completely non-electrostatic, will not sag, buckle, warp, or bend, and are scratch resistant, and have received UL approval with a listed flame-spreading rating of 25. The panels are said neither to burn nor shrink when heat is applied. An open-cubicle construction permits a free flow of air from the **(To page 232)**

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lighting fixtures. The panels, anchored by a suspension system may be installed over an entire ceiling area, below the lighting source, air conditioning system, and sprinkler systems.

PP fiber

Commercial production of low-denier polypropylene fiber has been announced by Reeves Brothers Inc. The new product is available both as staple and in the form of continuous multi-filament yarns. Gages of individual filaments range from 3 to 22 denier, the company states.

New route to acrylonitrile

A process based on a single-step direct conversion of refinery propylene and anhydrous ammonia to produce acrylonitrile has been discovered and developed in the Sohio Research Center, which is located in Cleveland, Ohio.

The first commercial plant to use the new process is being built in Lima, Ohio, and is scheduled to go on stream early in 1960. Sohio Chemical Co., totally owned subsidiary of The Standard Oil Co. (Ohio), will operate the plant and market its products.

Molds for concrete

Vinyl plastisol molds based on B. F. Goodrich Chemical Co.'s Geon 121 resin are now being used to mass produce ancient-type cathedral stone. The process was developed by Precast Building Sections Inc., New Hyde Park, N. Y., and involves casting of a preliminary mold that incorporates integral stainless steel tubing for heating and cooling. The vinyl plastisol is then poured into a preheated aluminum mold and allowed to gel. After it has cooled, the vinyl mold—into which the concrete is ultimately poured—is stripped from the aluminum shell.

Epoxies

Free sub-license. Hooker Chemical Corp. has signed a license agreement with General Electric Co. permitting use of Hooker's HET anhydride for **(To page 234)**

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curing of epoxy resins under a GE patent. Customers of Hooker's Durez Plastics Div. automatically will be held free and harmless under that patent when HET anhydride is used.

This hardener is said to contribute fire resistance, high temperature strength, and stiffness at temperatures up to 200°C. Glass cloth-reinforced laminates tested at 178°C. are reported to have a flexural strength of 73,500 p.s.i.

Reducing agent. A viscosity modifier, called Terpox, has been introduced as a new reducing agent for use with epoxy resins by Heyden Newport Chemical Corp. It is a liquid oxy derivative of a turpene said to be readily miscible at room temperature.

The modifier is applicable to both amine and anhydride cured epoxy systems. According to the company it promotes penetration and wetting in the system and permits increased filler loading of epoxies for potting, casting, laminating, coating, adhesives, and patching compounds.

Patching compound. An epoxy floor surfacing material, called Stonclad, is available from Stonhard Co. Inc., 401 N. Broad St., Philadelphia 8, Pa. It is a dense, non-porous, self-curing formulation that can be applied on top of existing concrete, brick, metal, or wood surfaces, or it can be used for a complete new overlay, or for repair of damaged floors.

Coloring process. Epoxy printed circuit boards can be color-coded for identification in electronic installations by a new process developed by Colorite Industrial Dyers, New York, N. Y. The process utilizes a wide range of colors, including many specified by RETMA, that can be applied to the printed circuit board without affecting the performance of the circuit, the company states.

Dipping compound. A black thixotropic epoxy material that is said to produce an even non-dripping coat on pieces up to 1 in. cube is available from Houghton

Laboratories Inc., Olean, N. Y. Called Hysol 10-80, the compound has been developed for encapsulating by dipping small electrical components, such as ceramic wafer capacitors, resistors, and small transformers. 10-80 is said to have passed the temperature and immersion cycling tests set down by MIL-C-11015A.

The company has also produced a new epoxy butter compound called Hysol 10-55 for protecting electric motor stator windings against moisture, dirt, abrasives, chemicals, and other contaminants. This is a 2-component system, which is mixed 1 to 1 by volume. It is said to have excellent thixotropic characteristics, which allows the use of a simple "butter technique" in its application even on hot stators. The usual curing oven temperatures are used for preheating the motor and for curing the compound.

New companies

Moorhead Plastics Inc., formed by the Greater Moorhead Development Corp., will manufacture fibrous glass boats in Moorhead, Minn. The company is currently operating from temporary quarters at Hawley, Minn. A new building is scheduled for completion in January 1960. **John Buckman** is president.

Amplast Inc., 2962 Park Ave., New York, N. Y., is a new supplier of virgin methacrylate sheets, rods, and tubes. It was formed by **Nat Yoffie** and **Sam Lipitt.**

Koveron Korporation, 122 S. 4th St., Louisville 1, Ky., was formed to manufacture unsupported vinyl sheet for wall covering and other interior decorating purposes. The product is supplied in 44 colors, 54 in. wide, in a basket weave or leather grain design. **W. T. Mason** is president.

Arkon Products Inc., 95 Prince St., Paterson 1, N. J., is a new company formed from the former Arkon Plastics Div. of The Linen Thread Co., and now owned by **The Frank A. McBride Co.** The company will continue to develop closed-cell PVC foam products, and granted ex- (To page 236)

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clusive distributorship of the Ark fish net floats in the United States to the former owners. The Arkon line includes foams from 4 to 20 lb./cu. ft. density and from soft upholstery material to rigid foams. **Joseph A. McBride** is president, **Edward G. Feddema,** formerly in charge of the Plastics Div. of Linen Thread, and **J. Nevins McBride** are vice-presidents.

Insta-Mold Plastics Corp., 64 Water St., Stonington, Conn., is a recently-established custom molder of expanded polystyrene for packaging and consumer items.

Expansion

National Starch & Chemical Corp. is increasing its research and technical development facilities by more than 50% with the construction of two new buildings at the company's Alexander Research Laboratories, Plainfield, N. J. One of the buildings will house the central manufacturing department as well as several technical development departments. The new laboratory unit will be occupied by the structural products, starch research, and control methods lab groups.

W. R. Grace & Co., on behalf of its **Dewey & Almy Chemical Div.,** has acquired the assets of **Endura Corp.,** Quakertown, Pa., and the stock of **The Vellumoid Co.,** Worcester, Mass.

Endura manufactures impregnated papers for high-pressure laminates, pressure-sensitive tape backings, and latex-impregnated tape backings. Vellumoid is a manufacturer of non-metallic gaskets, which include impregnated fiber gaskets and packing and latex-impregnated materials.

Dewey & Almy plans to use the acquisitions as part of its Polyfibron (polymers-fibers) Div. headed by **Russell L. Haden Jr.,** general manager.

Phillips Chemical Co., a wholly-owned subsidiary of **Phillips Petroleum Co.,** will further expand ethylene capacity at its Texas plant 35 mil- **(To page 238)**

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lion lb. a year. This expansion will raise the plant's annual capacity to 290 million lb. when completed in the second quarter of 1960. It is in addition to a 75-million-lb. expansion which was completed in October.

Phillips completed its original 180 million lb./yr. plant in 1957.

Olin Mathieson Chemical Corp. has announced a two-year expansion program for its Packaging Div., calling for a total investment of $12 million. The program is part of a five-year plan to provide for future growth within Olin Mathieson's six principal areas of activity—chemicals, metals, packaging, pharmaceuticals, energy, and sporting arms and ammunition.

Last month the corporation announced a $30 million expansion in its Chemicals Division.

Intercontinental Chemical Corp. will construct a 40,000-sq.-ft. building in Mountainside, N. J., which will be the new home for **Carbic-Hoechst Corp.; Hostachem Corp.;** and **Hostawax Co.;** technical representatives and distributors for the products of **Farbwerke Hoechst AG.,** West Germany; and **Hoechst Chemical Corp.,** West Warwick, R. I.

Carbic-Hoechst Corp., which sells dyestuffs, pigments, and textile chemicals, will have a laboratory for customers' service and application research, and a warehouse at the new location.

Hostachem Corp. and Hostawax will relocate their sales offices for chemicals and waxes to the new address. The executive offices of Intercontinental Chemical Corp. and Hoechst Pharmaceuticals Inc. will remain at 350 Fifth Ave., New York, N. Y.

Shawinigan Resins Corp. plans a 100% expansion of its multimillion lb. production capacity for Gelvatol polyvinyl alcohol resins. Construction has started and will be completed by the end of the year. The additions will make it possible for Shawinigan to produce sufficient quantities of the large volume standard

grades, and will also permit greater diversification into the smaller volume, specialty grades.

Monsanto Chemical Co. plans to develop a research center at the company's general offices location in Creve Coeur, St. Louis County, Mo., which is expected to be completed in 1961.

The center will house only laboratory and related activities; there will be no manufacturing or industrial activity involved. Ultimately most of the company's research will be centered here.

The new center will provide research facilities for the Inorganic Chemicals, Organic Chemicals, Research & Engineering, Plastics, and Lion Oil Co. Divisions. Much of the personnel involved in the initial program—about 400—will be transferred from Dayton, Ohio and El Dorado, Ark. The transfers to Creve Coeur will not be accomplished for two years.

Monsanto Argentina S.A.I.C., a wholly-owned subsidiary of Monsanto Chemical Co., is installing facilities to produce polyvinyl chloride compounds at its plant in Zarate, near Buenos Aires. Compounding operations are expected to get under way in the first quarter of 1960.

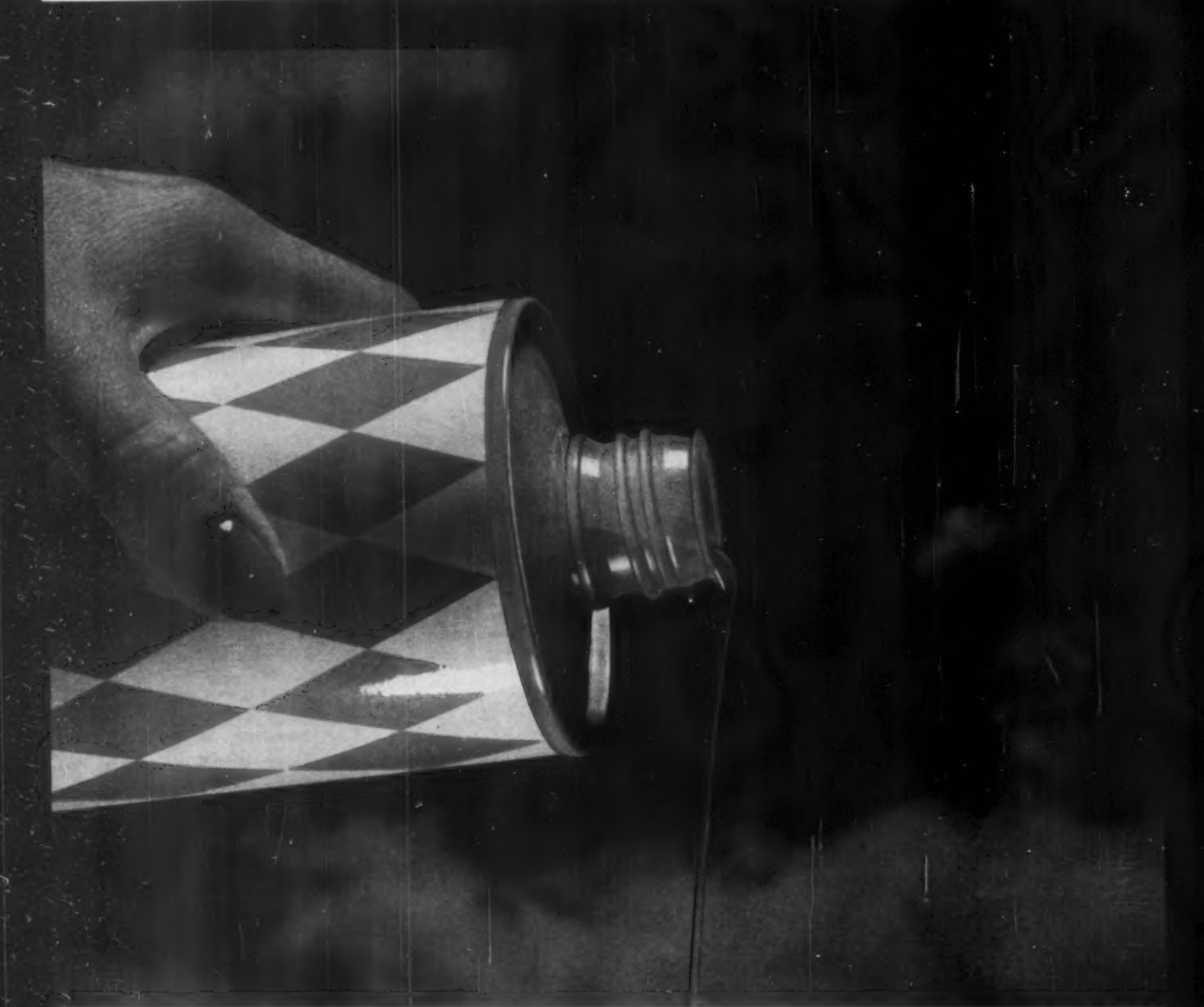
The Argentine company also is constructing facilities to manufacture phthalic anhydride, some of which will be marketed, while the remainder will be used internally to produce DOP plasticizer to be used in the PVC compounding. PVC resin for the compounding operation will be supplied by **Monsanto Andes S.A.I.C.**, another Argentine subsidiary.

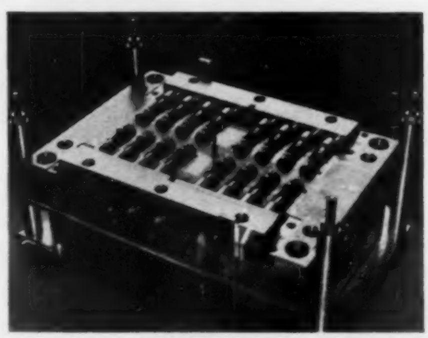
Carbide Chemicals Co., division of **Union Carbide Canada Ltd.,** is constructing a polyethylene customer service and product development laboratory at the site of the company's plastics and synthetic chemicals plant at Montreal East. The new facilities are scheduled for completion before the end of the year and will complement the 60% increase in production capacity of the company. Equipment available for customer service and product development purposes will permit injection molding and extrusion, continuous laminating, wire coating, pipe extrusion, and various types of film manufacture.

According to **A. A. Cumming,** president, more than 20% of the company's PE sales are in compounds which have been developed at the Montreal East plant within the last two years to meet the specialized requirements of Canadian fabricators.

Johns-Manville will increase production facilities for fibrous glass yarns and roving at Waterville, Ohio and Parkersburg, W. Va. Completion of the additional manufacturing capacities at both locations is scheduled for 1960.

Expansion of fibrous glass manufacturing has been increasing since December 31, 1958, when the company acquired the former L.O.F. Glass Fibers Co. of Toledo with six plants and a Technical Center. With completion of the current program, Johns-Manville will have in- **(To page 241)**





This die, made of Bethlehem Lustre-Die tool steel, produces the plastic threaded spout for detergent can shown above.

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creased total fibrous glass productive capacity by 50% since the date of acquisition, officials said.

Emery Industries Inc. announced a $6 million plant expansion project, which will increase the existing capacity for production of azelaic and pelargonic acids from oleic acid by ozone oxidation. This program includes plans to increase several fold esterification capacity for Emery's line of Plastolein plasticizers.

Diesters of azelaic acid are widely used as low-temperature plasticizers. Pelargonic acid is used in the manufacture of resins and polymers. Both acids have found substantial new markets in jet engine lubrication.

The Borden Chemical Co. has expanded its North Andover, Mass. vinyl extrusion plant. The company has installed four new extrusion machines and other equipment, which will be used to manufacture reinforced garden hose claimed to have very high burst strength while weighing 20% less than customary vinyl hoses. Plans also are under way at North Andover for the expansion of the company's vinyl shoe welting operations.

Atkins & Merrill Inc., Sudbury, Mass., industrial model builder, has opened a new West Coast facility and has formed a wholly-owned subsidiary, **Atkins & Merrill West Inc.**, located at Anaheim, Calif. The new plant will be staffed and equipped to manufacture industrial models, full scale mock-ups, fibrous glass components, and training devices.

Bruce Patton, formerly with Fluor Corp. Ltd., is vice-president and general manager of the new subsidiary. **Win Cobb** of the parent company's sales staff has been appointed sales manager.

Plastichimie S. A., a new French company jointly owned by **Dow Chemical International Ltd. S. A.** and **Pechiney S. A.**, is building a multimillion-dollar plant at Ribecourt, near Paris, where Pechiney operates a large **(To page 243)**

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(*From page 241*)

manufacturing facility which will become part of the new corporation. The plant will manufacture Styron polystyrene and saran. Start of operations is scheduled for 1961.

Standard Railway Equipment Mfg. Co. has begun construction of a plastics laboratory building at its Hammond, Ind. plant site. The new facility will be used for the development of new products and processes for reinforced plastics in transportation, process equipment, and architecture.

Dorsett Plastics Corp., Santa Clara, Calif., has opened a new plant for production of Dorsett Boats in Bremen, Ind. The new plant covers 200,000 sq. ft. on a 22-acre tract.

General manager of the new plant is **John B. Moore Jr.,** a naval architect. **Lynn Welland** is plant production superintendent.

The Electric Storage Battery Co. has acquired **Chemical Linings Inc.,** Watertown, N. Y., designers and fabricators of corrosion-resistant linings, tanks and towers. The company will remain under the same management but will be supervised by **The Atlas Mineral Products Co.,** Mertztown, Pa., a wholly-owned subsidiary of ESB, which manufactures fabricated plastics equipment and corrosion-resistant cements.

California Molded Products Inc., which recently acquired **Capac Inc.,** manufacturer of melamine dinnerware, is constructing a 16,000-sq.-ft. plant in Santa Paula, Calif. Completion of the building is anticipated in December of this year, and the company will then transfer its compression molding facilities from Ontario, Calif. to the new site.

Deceased

Thomas G. Rowden, until recently manager of the London office of Modern Plastics and Modern Packaging, died Oct. 9 in a London hospital, after a lengthy illness. Representing the two Breskin publications **(To page 244)**

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since 1953, Mr. Rowden was widely known in packaging and plastics circles in Britain and on the Continent.

Frederick W. McIntyre Sr., 72, died Oct. 8, in Worcester, Mass. He retired as chairman of the board of the **Reed-Prentice Corp.** of Worcester in November 1954, and became a resident of Bal Harbour, Fla. in 1956.

Meetings

Plastics groups

Nov. 19, 20: (British) Plastics Institute, "The Influence of Plastics in Building," Royal Institute of British Architects, 66 Portland Pl., London W.1, England.

Nov. 19: Society of Plastics Engineers, Inc. (S.P.E.) Golden Gate Section, Retec, "Plastics in Packaging," San Francisco, Calif.

Dec. 1: S.P.E., Washington-Baltimore Section, in cooperation with the Deterioration Center, National Academy of Science, Washington, D. C.

Other meetings

Nov. 12, 13: Chemical Market Research Association, "Plastics—End Use Markets for High Polymers," Sheraton Towers Hotel, Chicago, Ill.

Nov. 16-19: Building Research Institute, Fall Meet, "Curtain Walls, Sandwich Panels," including workshop on "Sandwich Panel Design Criteria," Shoreham Hotel, Washington, D. C.

Nov. 17-20: Packaging Machinery Manufacturers Institute, "PMMI Show 1959," Coliseum, at Columbus Circle, New York, N. Y.

Dec. 3-5: American Chemical Society, Southwest Regional Meeting, four symposia, including "Polymerization Chemistry," Capitol House, Baton Rouge, La.

Dec. 8-10: American Institute of Electrical Engineers and National Electrical Manufacturers Association, 2nd National Conference on the Application of Electrical Insulation, Shoreham Hotel, Washington, D. C.—**End**

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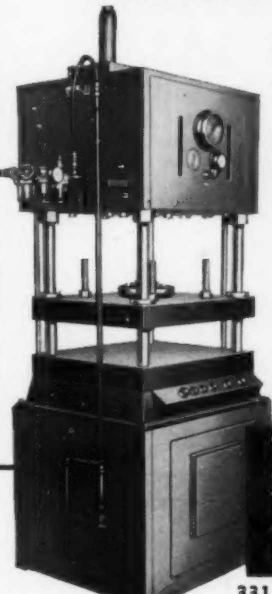

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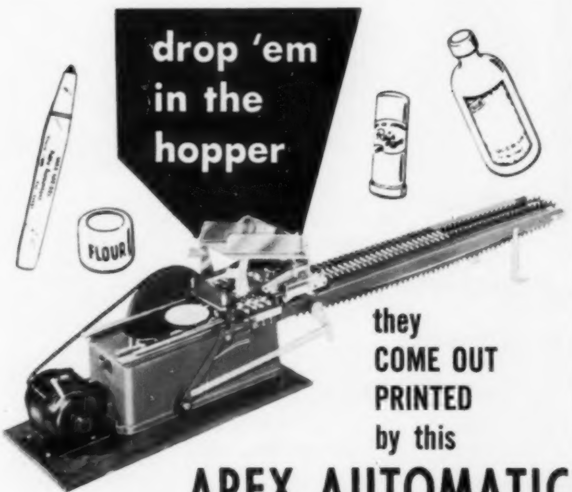

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Kunststoffe 1959—a preliminary report

Visitors who flocked to Düsseldorf, Germany, from all over the world found that this third International Plastics Fair fully reflected the progress that has been made in the plastics industries since the last show in 1955. The possibilities which were hinted at only a few years ago have now been translated into new materials, refined processes, and improved machinery which in turn have opened up many new world-wide markets.

The most remarkable progress was among the machinery exhibits where a wide range and diversity of processing equipment included some really new developments such as a method of bi-orienting polyethylene pipe. Exhibitors were wise and courageous enough to show machines that are still in the development stage, so that the questions raised by interested visitors at the fair might guide them in perfecting their equipment when later they launch full-scale production.

Business in the machinery section was so successful that delivery dates of processing equipment are now 18 months to two years, compared with about six months ago. A detailed report of the machinery shown and of developments which are coming soon will appear in a forthcoming issue.

It was generally felt that visitors from the United States set a new high standard of knowledgeable and interested prospects.

Of special significance is the increasing number of cross-licensing agreements and know-how "trades" between Americans and European machinery makers, so that all the world may benefit from the total new know-how, with parts and services available to customers everywhere.

European machinery manufacturers have learned the importance of ever-increasing production rates to the American processor. They have also come to realize that they must have their own organization or highly qualified representatives in the United States; that they must provide technical service; carry stocks for spare parts and replacement; and

that adequate financial backing is essential for participation in the American market.

Some interesting developments in the raw material sector will also be reported, especially the impact made by chlorinated polyethylene, sometimes alloyed with vinyls (see p. 43, this issue). Although end products are generally better designed in the United States because our design standards are probably higher to satisfy our more sophisticated consumers, some items shown in Düsseldorf deserve comment, and will be described in the full show report.

The effectiveness of a show of such importance and scope depends to a considerable extent on the organization and facilities for exhibitors and visitors. The stands and exhibits were exceptionally well planned and very attractive. Technical personnel, frequently good linguists, were in attendance. Interpreters were available and literature in foreign languages was also provided in many cases.

However, to exhibitors and particularly to trade visitors, the crowds of housewives and children that swarmed through the fair seriously interfered with the true purpose of the exhibition. On many occasions machinery demonstrations had to be abandoned because crowds of idle spectators prevented potential customers from getting near machines. This demonstrates the importance of restricting visitors to trade fairs.

Among the general excellence of the arrangements made by the organizers and the overwhelming demonstration that Düsseldorf knows how to run a show, two serious defects stood out. Hotel accommodation was inadequate and did not offer the minimum comfort required to refresh visitors after a day's hard work. Many people had to travel an hour or more to and from the fair. This inconvenience was further complicated by chaotic traffic conditions which included every handicap known to motorists, such as lack of parking facilities, too few taxicabs, traffic jams, etc.

Nevertheless, the fair was an outstanding achievement for all concerned and its importance will be fully analyzed in a subsequent Modern Plastics article.—**End**

COMPANIES...PEOPLE

Appointments, promotions, and relocations in the plastics industry.

W. R. Grace & Co.: Dr. Robert E. Gilman and **Dr. Wendell C. Overhults** joined the staff of the Research Div. as research chemists.

Dewey & Almy Chemical Div.: Charles E. Brookes, formerly sales mgr.—organic chemicals, appointed to newly-created post of mgr.—marketing. **John G. Broughton** named field sales mgr.

Celanese Corp. of America—Celanese Plastics Co.: James W. Flynn succeeds **Dr. W. Paul Moeller** who resigned, as sales mgr. **Dr. Howard L. Pilat**, formerly dir.—new chemical development, succeeds Mr. Flynn as mgr.—market development.

Flynn

Pilat

Allied Chemical Corp.: W. A. Peters Jr. named mgr.—marketing—Western operations, responsible for coordinating the Western sales activities of the company's operating divs., with headquarters located in Los Angeles, Calif.

National Aniline Div.: Dr. L. W. Seigle, previously mgr.—chemical sales, now asst. to the dir.—chemical sales, responsible for the commercial introduction of new products. **J. E. Loughlin** named mgr. of the newly-formed tech. service group which will concentrate on problems in isocyanates and urethanes.

Plastics & Coal Chemicals Div.: Homer Yaryan named sales rep. for Plaskon polyester and molding compounds in the West Coast area.

Monsanto Chemical Co.: Dr. Wendell P. Metzner, formerly an assoc. dir. of research in the Organic Chemicals Div., appointed adm. dir. of the new research center, St. Louis, Mo.

Plastics Div.: David M. Williamson promoted from asst. dir.—mfg. to newly-created post of dir.—mfg. for the West Coast. **Roland H. Dunlop**, formerly mfg. supt., named plant mgr. at Santa Clara, Calif.

At Texas City, Texas, **Robert H. Sobotik** joined the tech. services dept. of the Plastics Div.

The Dow Chemical Co.: Douglas S. Chisholm will head the newly-formed Long Range Plastics Application Laboratory, which will concentrate on the physical and mechanical manipulation of plastics. The laboratory's activities will be mainly problem-oriented rather than center on specific plastics materials, and will be particularly concerned with tackling long-range problems in the building industry.

Waldron-Hartig Div. of **Midland-Ross Corp.** is the name of the newly combined **John Waldron Corp.**, manufacturer of flexible couplings and process machinery for plastics, film, foil, and paper webs; and of **Hartig Extruder Div.** The manufacturing facilities, sales, and engineering of the two affiliated companies of Midland-Ross Corp. will continue to operate as in the past.

Fabricon Products, a div. of **Eagle-Picher Co.: John T. Watkins, Jr.**, formerly asst. to the VP, now gen. mgr.—plastics impregnating div. **H. Robert Lyon**, previously asst. chief chemist, named development engineer of the div. **Kenneth Iseler** appointed supv.—quality control. **Roger C. DeNoyelles** promoted from sales rep. to sales mgr. of the export dept.

Reichhold Chemicals, Inc.: Robert A. Schmittberger to head the newly-formed phenolic molding compounds dept. **James J. Maher** appointed rep. in the Plastics Div., responsible for sales development and promotion of plastics applications for the company's Epotuf epoxy resins. He is a co-author of a study on these resins prepared by Harvard Graduate School of Business Administration.

Eastman Chemical Products Inc., subsidiary of **Eastman Kodak Co.**: The plastics div. opened a new sales office in Fort Washington Industrial Park in Philadelphia, Pa., headed by **Thomas L. Loveless.**

MacKenzie Chemical Works Inc. has rebuilt its Central Islip, N. Y. plant which was recently destroyed by fire, and resumed full production of acetylacetonates of iron, chromium, zinc, cobalt, and other metals, with end uses as combustion, oxidation, and curing catalysts for acrylic and polyester resins.

National Blow Molding Co. is the new name of **Mahl Industries Inc.**, 498 E. 167 St., New York, N. Y.

Packaging Machinery Mfrs. Institute Inc.: The following officers were elected for two-year terms to begin Jan. 1, 1960: Pres., **Kenneth B. Hollidge, Arthur Colton Co.**, Detroit, Mich.; 1st VP, **W. R. Huguenin, Food Machinery Mfg. Co., Packaging Machinery Div.**, Philadelphia, Pa.; 2nd VP, **Harold Mosedale Jr., Package Machinery Co.**, East Longmeadow, Mass.; 3rd VP, **William W. Anthony Jr., Crompton & Knowles Packaging Corp.**, Holyoke, Mass.

O'Sullivan Rubber Corp., Winchester, Va.: **C. Robert Creamer Jr.**, formerly sales mgr., plastics div., and **Charles A. McKenney Jr.**, previously asst. to the pres., were elected VPs.

Industrial Plastic & Equipment Co. Inc., distributors, custom molders, and fabricators of Kel-F, Teflon, nylon, and phenolics, moved from Elizabeth, N. J. to larger quarters at 116 Main St., Orange, N. J.

Atlantic Gummed Paper Corp., Brooklyn, N. Y., added a Polyethylene Coated Products Div., which will be headed by **Marvin Frankel.**

Penn-Plastics Corp., Glenside, Pa.: **Andrew A. Dukert** and **Arthur H. Newton** elected VPs of the firm and subsidiary, **Penn-Plastics Mfg. Co.**

Chemical Market & Research Co. moved its offices from 10 E. 39th St. to 232 Madison Ave., New York 16, N. Y. The company was established last year to conduct marketing and research studies in polymers, particularly plastics and resins.

R. E. G. Windsor, managing dir. of **The Windsor Group of Companies**, also appointed chrmn. succeeding **Arthur Dennis**, who resigned because of ill health. The Group comprises **R. H. Windsor (Holdings) Ltd., Webley & Scott Ltd., R. H. Windsor Ltd.** as well as its home and overseas subsidiaries.

Windsor

Walter J. Kilmer made mgr. of the Detroit Sales Div. for **U. S. Industrial Chemicals Co.**, div. of **National Distillers & Chemical Corp.**, in succession to **Fred M. Henley**, who recently retired.

James F. Keel named supt. of film and fiber mfg. at **AviSun Corp.'s** New Castle, Del. plant.

W. P. Dunlap named plant mgr. of **Mobay Chemical Co.**, Martinsville, W. Va. He succeeds **Donald J. Miller**, who accepted a position with Monsanto Chemical Co.'s Plastics Div. in Texas City, Texas.

Frank J. McLeod named Midwestern dist. sales mgr. for **American Alkyd Industries**, Carlstadt, N. J. He will supervise sales of **(To page 252)**

The Molder's Molding Machine....... The New NATCO 400 gives you.

- 28 oz. SHOT — single feed!
- PARTS UP TO 15" DEEP — Fast!
- DEPENDABILITY because it's shockless!

Shot capacity	28 oz.
Clamp pressure (max.)	425 Tons
Platen size	38" x 38"
Daylight (max.)	50"
Plasticizing capacity	165 lbs. per hr.
Stroke (max.)	26"
Horsepower	47½

For over fifty years, designers and builders of automatic production machinery.

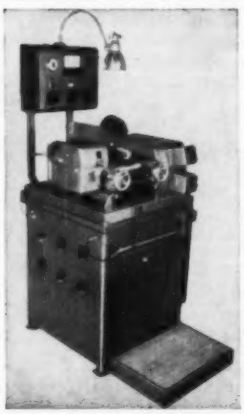
Versatile Natco Injection Molding Machines are available in stock sizes with shot capacities ranging from 12 to 85 oz. All are compact, self-contained units; all feature Natco's exclusive "closed-circuit" hydraulic system. Call or write today.

Ask for Bulletin 4001.

NATCO PLASTICS MACHINERY DIVISION

National Automatic Tool Co., Inc.
RICHMOND, INDIANA

Representatives in principal cities.



SPECIALIZED MANUFACTURERS

DEVELOPMENT AND CONSTRUCTION OF PROTOTYPES

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DEVELOPMENT OF TECHNICAL PROCESSES

- Specialized commercial laboratory apparatus, singly and in moderate quantities.
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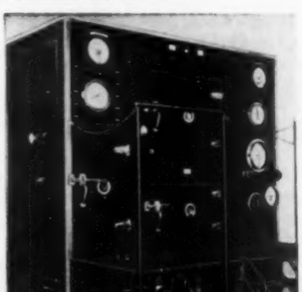
2 APPARATUS FOR CYCLED AGEING
3 COMPOSITE EQUIPMENT: MIXING-CALENDERING, AGEING AND PRE-HEATING EQUIPMENT, COMPRESSION MOULDING AND INJECTION MOULDING/EXTRUSION



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Compounds for Extrusion and Molding

Alpha Chemical and Plastics Corp.
11 JABEZ STREET,
NEWARK 5, N. J.
TEL. MARKET 4-4444

COMPANIES...PEOPLE

(From page 250)

Amester polyester resins to the boat, preform, premix molders, and automotive plastics manufacturers.

Donald H. Brewer, formerly sr. VP of Container Corp. of America, elected VP of **Rexall Drug & Chemical Co.** He will be located in the company's world headquarters in Los Angeles, Calif. and will be the Rexall corporate officer in charge of all plastics processing operations.

The divs. and subsidiary companies engaged in the plastics and allied fields, which will report to Mr. Brewer, include: **Injection Molding Co.**, Kansas City, Mo., mfr. of plastic bottles and containers; **Tupper Co.**, Woonsocket, R. I., mfr. of plastic housewares; **Chippewa Plastics Inc.**, Chippewa Falls, Wis., mfr. of plastic film; **Kraloy Plastic Pipe Co. Inc.**, **Chemtrol**, and **E & A Sales**, all of Los Angeles, Calif., mfrs. of PVC pipe and plastic valves and fittings.

Elwood W. Phares appointed sales mgr. of **Cary Chemicals Inc.**, East Brunswick and Flemington, N. J., producers of PVC resins and PVC-VA compounds.

Daniel W. Kallman named sales mgr. of **The Nalge Co. Inc.**, Rochester, N. Y., mfr. of plastic lab apparatus.

Frank H. Manley Jr. named Western area sales-service representative of **Falls Engineering & Machine Co.**, Cuyahoga Falls, Ohio.

Glenn Carnine, formerly quality control chemist at Becco's Vancouver, Wash. plant, appointed to newly-created position of chief control chemist at the Buffalo, N. Y. main plant of **Becco Chemical Div., Food Machinery & Chemical Corp.**

William D. Gersumky, formerly of the Stamford, Conn. research laboratories of American Cyanamid Co., joined the industrial consulting firm of **Robert S. First Inc.**, New York, N. Y., as VP and dir.

R. L. Hawkins joined the tech. service laboratories of **Colton Chemical Co.**, Cleveland, Ohio, a division of **Air Reduction Co. Inc.**, and he will handle technical service for polyvinyl alcohol.

R. J. Stankus appointed to the research laboratory staff of **Polyvinyl Chemicals Inc.**, Peabody, Mass.

Charles R. Good named VP—marketing of **Continental Plastics Inc.**, Oklahoma City, Okla., makers of custom and proprietary products.

Emory F. Ridlon appointed to the newly-created position of production mgr. for Mylar **(To page 256)**

DOW **Plastiatrics**

DOW'S CLINICAL APPROACH TO HEALTHY PLASTICS APPLICATION

NEW EPOXY SYSTEM MAKES ADVANCED TV TUBE DESIGN PRACTICAL

DOW DEVELOPMENT CAPITALIZES ON EPOXY'S GLASS ADHESION, STABILITY, CLARITY

A leading TV tube manufacturer recently presented Dow with a problem involving the laminating of glass panels. They had developed an advanced design for a square-face TV tube which required the laminating of a contoured implosion safety panel directly to the face of the tube. The design would provide greater safety against implosion, produce a brighter picture, eliminate the conventional, dust-catching, separate safety panel and permit the building of slimmer sets. To accomplish this, the manufacturer required a special laminating system and resin material which would meet the following requirements:

1. The method must be adaptable to mass production.
2. The method must provide a stable, adhesive bond to glass.
3. The resulting laminate must be able to withstand rough handling.
4. The resulting laminate must be able to withstand extreme changes in humidity and temperature.
5. Resulting optical properties must be acceptable by E.I.A. color standard for television.

DOW EPOXY RESINS

Liquid Resins—For casting, laminating and adhesives

D.E.R.* 332— Nearly water-white
D.E.R. 331— Coatings and laminating
D.E.R. 334— Lowest viscosity

Solid Resins—For Pre-preg and Coatings.

D.E.R. 661— Nearly water-white—Amine cure.
D.E.R. 667— Nearly water-white—Maximum hardness
D.E.R. 664— Epoxy exters

Dow Epoxy Novolacs

Thermosetting epoxy resins for high temperature use—up to 500° F.

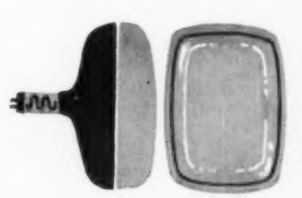
*Trademark

Because no available resin met all these requirements, Dow had to develop a special system which would solve the problem.

Dow's prior extensive research and development work on epoxy resins, coupled with Dow's basic raw material position, had produced new resins whose properties appeared to offer promise of fulfilling the stated requirements. Among these resins were several which were known to: provide high-strength bond to glass; produce stable, heat-and-shock resistant laminate interlayer; exhibit nearly water-white clarity after cure; cure quickly at relatively low temperatures.

Working closely with TV engineers and manufacturers of automatic blending and dispensing equipment, Dow chemists and technical service engineers tailored a unique epoxy system which met every requirement for successful mass production of the new square tube.

Plastiatrics studies, like the one described above, are part of a continuing program by Dow Coatings Technical Service engineers to aid Dow customers in the selection of coatings materials, and in technical matters relating to manufacturing techniques. For more information on Plastiatrics studies, write THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Sales Dept. 2377CS11.



Panel and tube faces are cleaned and preheated (150-200° F.)

Preheated parts are assembled and positioned properly.

Resin system is automatically injected, cures to handle in fifteen minutes.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

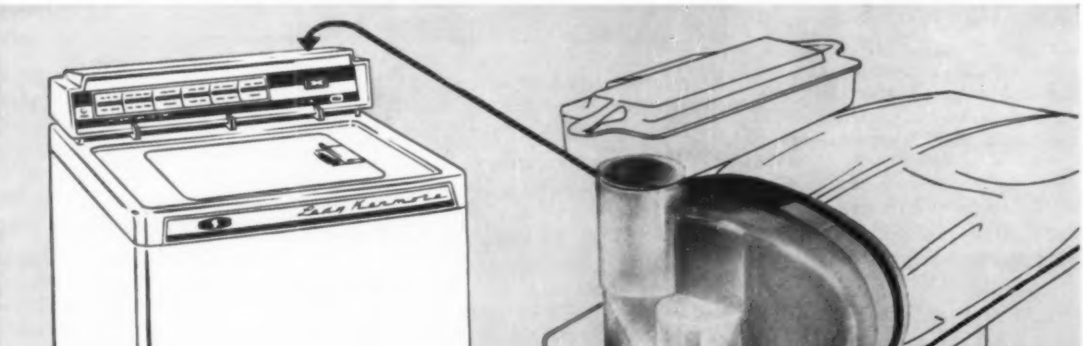
HERCULES

Plastics Hi-lites

Hidden values with new plastics

The inside story of seldom-seen parts performing demanding roles in new equipment

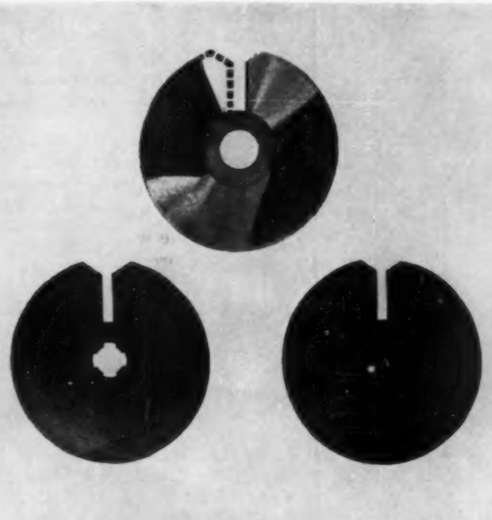
Today's consumer is prone to take advanced engineering features of new products for granted. Industrial users, too, have come to expect superior performance and greater serviceability from every piece of new equipment. Here are a few of the ways that design engineers are using Hercules new plastics to build added values into their products without increased cost. Able to work for the first time with thermo-plastics which are truly structural materials, they have found it possible to make one part do the work of many. Rapid-cycle injection molding produces the new precision-formed units at low cost, and the properties of the new materials provide the stamina and durability which assure faithful, trouble-free service.



Handsome styling, luxurious appointments, and its many extra service features have made the Lady Kenmore Clothes Washer one of the nation's best sellers. But it's the engineering and quality of construction inside the Lady Kenmore which enables Sears to maintain its reputation for *big value* merchandise. A significant example is the advanced design of the rinse dispenser developed by The Dole Valve Company, Morton Grove, Illinois, especially for this outstanding machine. The heart of the unit (shown in position in the diagram with the rest of the assembly in outline) is precision molded with Pro-fax®, Hercules' polypropylene. Pro-fax, the newest and most versatile of thermoplastic, provides a part that is immune to rust and the corrosive attack of detergents, highly resistant to heat, mechanically strong, and functionally sound.

How a one-piece Penton® Part replaced five individual parts

When Economics Laboratory, Inc. developed its new Drymaster*—a proportionate pumping system to automatically dispense its nationally known line of chemical formulations for commercial dishwashing—it faced the problem of finding a material to replace its conventional 5-piece bronze disc and carbon half-ball assembly. Failures in the Drymaster after only a few months of service were directly traced to wear of the disc and half-ball, and Economics Laboratory thoroughly evaluated more than 150 materials before selecting Penton®. The success of Penton in the



Here's dramatic evidence of Penton's superior wear characteristics after 100,000 gallons of 220°F. hot-water service. Slot in bronze disc (at top) has worn away to an extent that the meter no longer functions accurately Penton test disc (at left) remains relatively unchanged after same exposure, as compared with production line part (right photo).

Drymaster is typical of the way this versatile new thermoplastic can be precision-molded to provide superior, low-cost replacements for expensive machined metal parts.

Although one of the newest of plastics, Penton chlorinated polyether was exhaustively tested during five years of product evaluation prior to its recent introduction as a commercial material for use in such applications as: valves, pipe, fittings, tank linings, pump and meter parts.

For complete details on Penton, including a folder charting Penton's resistance at elevated temperatures to more than 250 chemicals, call or write Hercules.

**Tradename of Economics Laboratory, Inc., St. Paul, Minn. Information regarding meters and Disc and Half-Ball Assemblies is available from the Industrial Division, Economics Laboratory, Inc., St. Paul 1, Minnesota.*

Design Hi-lites

The idea of forming a complete plastic container having a molded hinge and catch to join the body and the lid is not new. However, prior to the advent of Pro-fax® polypropylene, it was not possible to achieve a tough, rigid unit of this type, with a hinge of virtually unlimited flex life and a tight-fitting, easily operable fastener.

The economic advantages of such an assembly—whether it is designed to serve as an appliance housing, in luggage, or for consumer packaging—are readily apparent. Fittings can be eliminated, together with the costs of finishing and assembly. In many instances, the completed part emerges from the mold, ready for shipment and use.

Whether you expect to use Pro-fax to exploit this special design feature, or because of its many other desirable properties, we'll be glad to help you with your product planning. Our technical service group has had extensive experience in designing, engineering, and processing Pro-fax for products of all types. It can assist you in the development of parts which will take optimum advantage of the properties of this versatile plastic, and, at the same time, minimize processing, finishing, and assembly problems.

A fine example of a handsomely styled new product which "hinges" on Pro-fax is the "Platter Porter", a new phonograph accessory which promises to become a teen-ager's "must". Designed and produced by Columbus Plastic Products, Columbus, Ohio, this portable case for 45rpm records is lightweight, colorful, with a striking leather-grain finish impervious to weathering, staining and hard knocks. With a molded hinge and catch, there's no risk of breakage at these key points, and at the same time this new approach to luggage design greatly simplifies assembly and finishing problems.

HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

HERCULES

THREE NEW MATERIALS FOR THE PLASTIC INDUSTRY

HI-FAX® HIGH-DENSITY POLYETHYLENE • PRO-FAX® POLYPROPYLENE • PENTON® CHLORINATED POLYETHER

CP59-20

COMPANIES...PEOPLE

(From page 252)

in **Du Pont's Film Dept.** He is succeeded by **Dr. Richard E. Heckert** as mgr. of the company's Circleville, Ohio plant, where Mylar is made.

Charles P. McClelland named assoc. dir. of **Union Carbide Chemicals Co.,** div. of **Union Carbide Corp.,** Tarrytown, N. Y.

J. C. Burkholder appointed mgr. of the Resin Div. of **Archer-Daniels-Midland Co.,** Minneapolis, Minn.

Harlan J. Hauser named mgr. of field sales of **Farrel-Birmingham Co. Inc.,** to succeed **D. Wheeler Clark.** He has been transferred from the Rochester, N. Y. plant to the general offices in Ansonia, Conn.

Richard G. Kadesch appointed research dir. of **Nepera Chemical Co. Inc.,** Harriman, N. Y., div. of **Warner-Lambert Pharmaceutical Co.** and mfr. of fine organic chemicals and pharmaceutical intermediates.

William W. Lewellyn appointed merchandising mgr. of **The Dayton Rubber Co.'s Foam Div.,** which supplies urethane and latex foam products to the bedding and furniture markets.

L. H. Haskin Jr. appointed to head the newly-formed printing equipment div. of **Inta-Roto Machine Co.,** Richmond, Va.

William H. Young Jr. named plant mgr. of **PharmaPlastics Inc.,** Baltimore, Md., custom and proprietary injection molders.

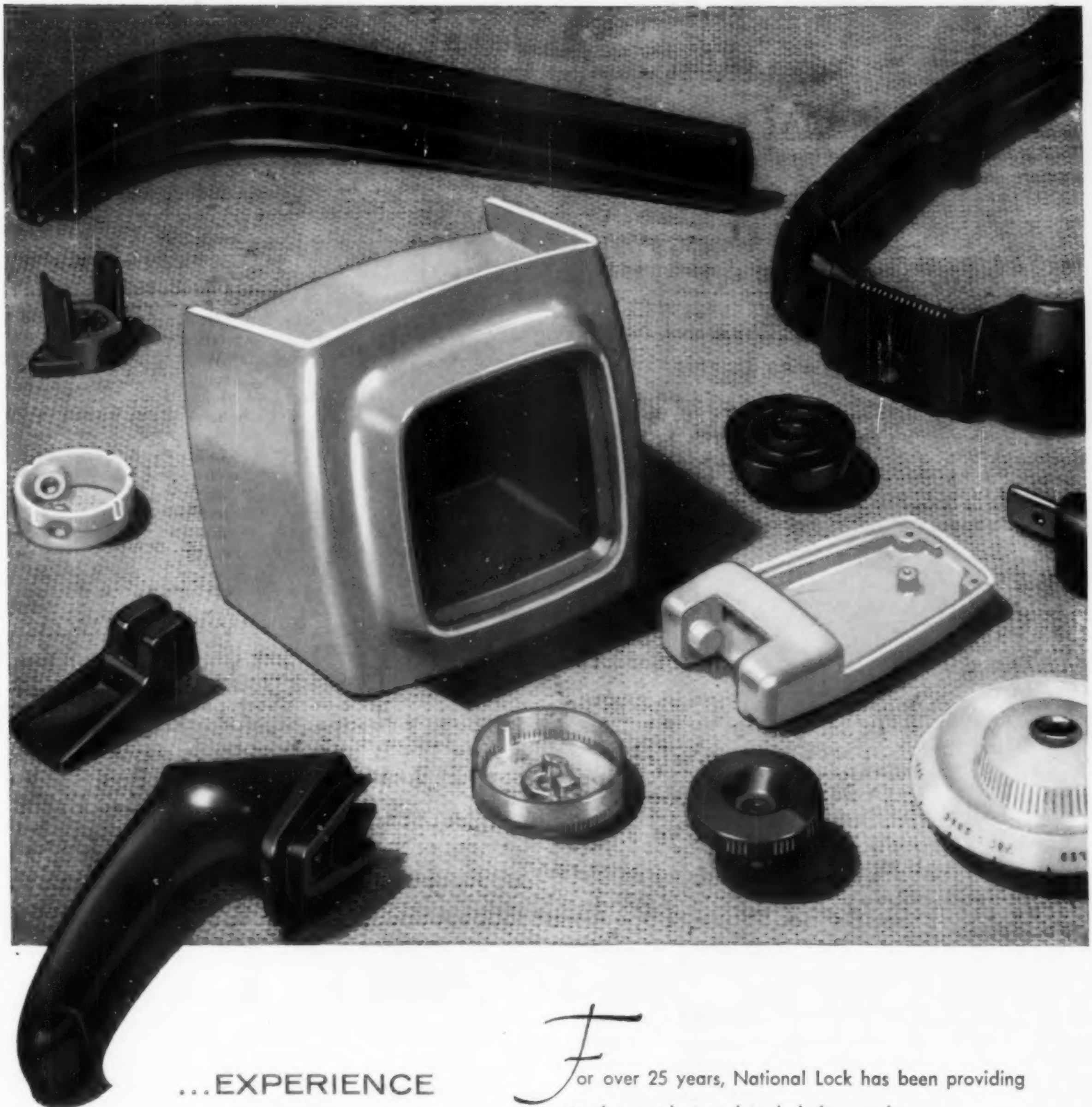
Joseph L. Huscher appointed VP of **Kaykor Industries Inc.,** div. of **Kaye-Tex Mfg. Corp.,** Yardville, N.J., mfr. of decorative and industrial laminates and vinyl coated fabrics.

Frank H. Kimball, formerly West Coast mgr. of the Panta-Pak Div. of The Pantasote Co., named VP in charge of West Coast operations of **National Packaging Corp.,** Fort Wayne, Ind., mfr. of vacuum formed plastic trays.

Alexander Leigh named sales mgr. for the **St. Regis Paper Co.'s Panelyte Div.'s** thermoplastic products. He will be located at the Dexter, Mich. plant. **Gerald Painchaud** succeeds Mr. Leigh as mgr. of the **Panelyte Foreign Dept.**

Saul Ricklin promoted from dir. to VP of development of **Dixon Corp.,** Bristol, R. I., makers of Rulon fluorocarbon products.

Fred C. Williams Jr. transferred from St. Louis, Mo. to become a branch mgr. of **(To page 258)**



(From page 256)

Wellington Sears Co., 175 S. Main St., Akron, Ohio. The company manufactures fibers for laminates and coatings.

Dr. Taylor Evans appointed mgr., market research of **Naugatuck Chemicals Div.** of **Dominion Rubber Co. Ltd.**, at Elmira, Ont., Canada.

Dr. C. C. Schulze appointed to the newly established position of asst. gen. mgr. of the **Dyestuff & Chemical Div., General Aniline & Film Corp.** He was formerly mgr. of manufacturing of the div.

Robert W. Bainbridge appointed asst. supv.—sales engineering for molding compounds at the **Durez Plastics Div., Hooker Chemical Corp.**, N. Tonawanda, N. Y.

Clarence H. Sigler Jr., former technical sales rep. in the Chicago, Ill. area, appointed Vibrathane polyurethane commodity sales mgr. for the **Naugatuck Chemical Div., U. S. Rubber Co.** He replaces **Arnold Rodde**, who joined **Texas-U. S. Chemical Co.**

George T. Howe appointed plant mgr. of **Polyplastex United Inc.**, Union, N. J.

George Koch named dir. of commercial development for **Nuodex Products Co.**, which is a division of **Heyden Newport Chemical Corp.**

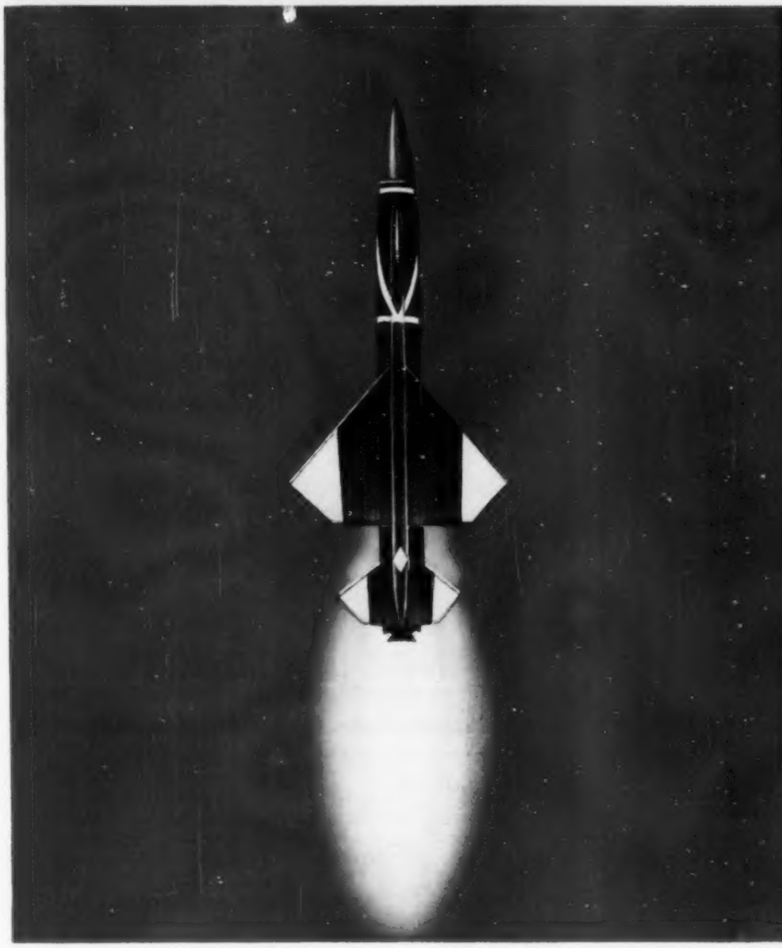
Charles H. Luling III named sales mgr. of the **Redmanson Corp.**, York, Pa., mfr. of molded polyethylene drums and tanks. He was formerly a sales engineer in the plastics div. of Phillips Chemical Co.

Peuchen Engineering Corp. is the new name of **Pecorp Inc.**, P. O. Box 3164, Wilmington 4, Del., manufacturer of portable water chillers for the plastics industry.

R. T. MacAllister elected VP for sales and advertising of **Formica Corp.**, subsidiary of **American Cyanamid Co.** He was formerly mgr., decorative products, and is succeeded by **R. E. Lilly.**

New reps.

W. Ronald Benson Inc., Seattle, Wash., appointed sales agent in Wash. and Ore. for **Shawinigan Resins Corp.**'s PVC resins and emulsions. Shawinigan will continue to maintain warehouses in Seattle and Portland, Ore., and sales offices in Los Angeles and San Francisco, Calif. . . . **Lathrop-Paulson Co.**, Chicago, Ill., named exclusive sales agent for **St. Regis Paper Co.**'s newly developed polyethylene milk case. . . . **Nawn Enterprises** **(To page 260)**



U. S. Air Force BOMARC Interceptor ground-to-air missile. Nose cone manufactured by Brunswick-Balke-Collender.

COMPANIES...PEOPLE

(From page 258)

Inc., 785 Main St., Holden, Mass., named rep. for **Spray-Bilt Inc.**, Hialeah, Fla. mfr. of the Spray-Bilt gun that shoots fibrous glass roving and resins simultaneously to form a waterproof plastic coating. . . . **Joseph & Canning Inc.** named sales rep. in New York City and surrounding area by **The Ceilcote Co.** for its line of industrial corrosion-proofing materials, which include linings, coatings, cements, adhesives, high-strength grout, and reinforced plastic ventilating systems and processing equipment. . . .

John V. Muddle Assocs., 74 Union St., Ashland, Mass., appointed exclusive sales rep. in Conn., Mass., Maine, N. H., R. I., and Vt. to handle **Gries Reproducer Corp.'s** products and services for the original equipment market . . . **Bronze Specialties Inc.**, Baltimore, Md., named distributor in Baltimore, Washington, D. C., Central Pa., and portions of Va. for **Synthane Corp.**, Oaks, Pa., mfr. and fabricator of industrial laminated plastics. . . .

John K. Bice Co. named exclusive distributor by **J. M. Huber Corp.** for its new series of kaolin clay extenders and Zeolex synthetic silicate pigments to the paint, varnish, printing ink, plastics and specialty processing industries in Southern Calif., Ariz., N. M., Utah, Colo., and Wyo. . . . **J. D. Robertson Inc.**, 3133 Maple Dr. N. E., Atlanta 5, Ga., to represent **F. J. Stokes Corp.**, Philadelphia, Pa., in the Southeastern U. S. . . .

. . . **Kayron Chemicals**, Montreal, Canada, appointed sales rep. for all of Canada by **Claremont Pigment Dispersion Corp.** . . . **Don Maier & Assocs.**, 6214 W. Manchester Ave., Los Angeles 45, Calif., appointed sales rep. of the Fiber Glass Fabrics Div. in Calif. and Ariz. for **Joseph M. P. Ott Mfg. Co. Inc.**, 87 Sabin St., Pawtucket, R. I. . . . **Schwartz Chemical Co.**, Long Island City, N. Y., named Eastern distributor of a wide line of adhesives made by **U. S. Rubber Co.** . . .

. . . **Peuchen Engineering Corp.**, P. O. Box 3164, Wilmington 4, Del., mfr. of portable water chillers for the plastics industry, appointed the following reps.: **Kavanagh Sales Inc.**, div. of **Standard Tool Co.**, Leominster, Mass.; **Plastics Molders Engineering Co.**, Chicago, Ill.; **Hans E. Buecken Co.**, Pico Rivera, Calif.; **Irving Paeff**, N. Miami, Fla.; **Southwest Sales Co.**, Dallas, Texas; **Barnett J. Danson & Assoc. Ltd.**, Toronto, Ont.; and **Marlin F. Keaton**, Woodstown, N.J. . . .

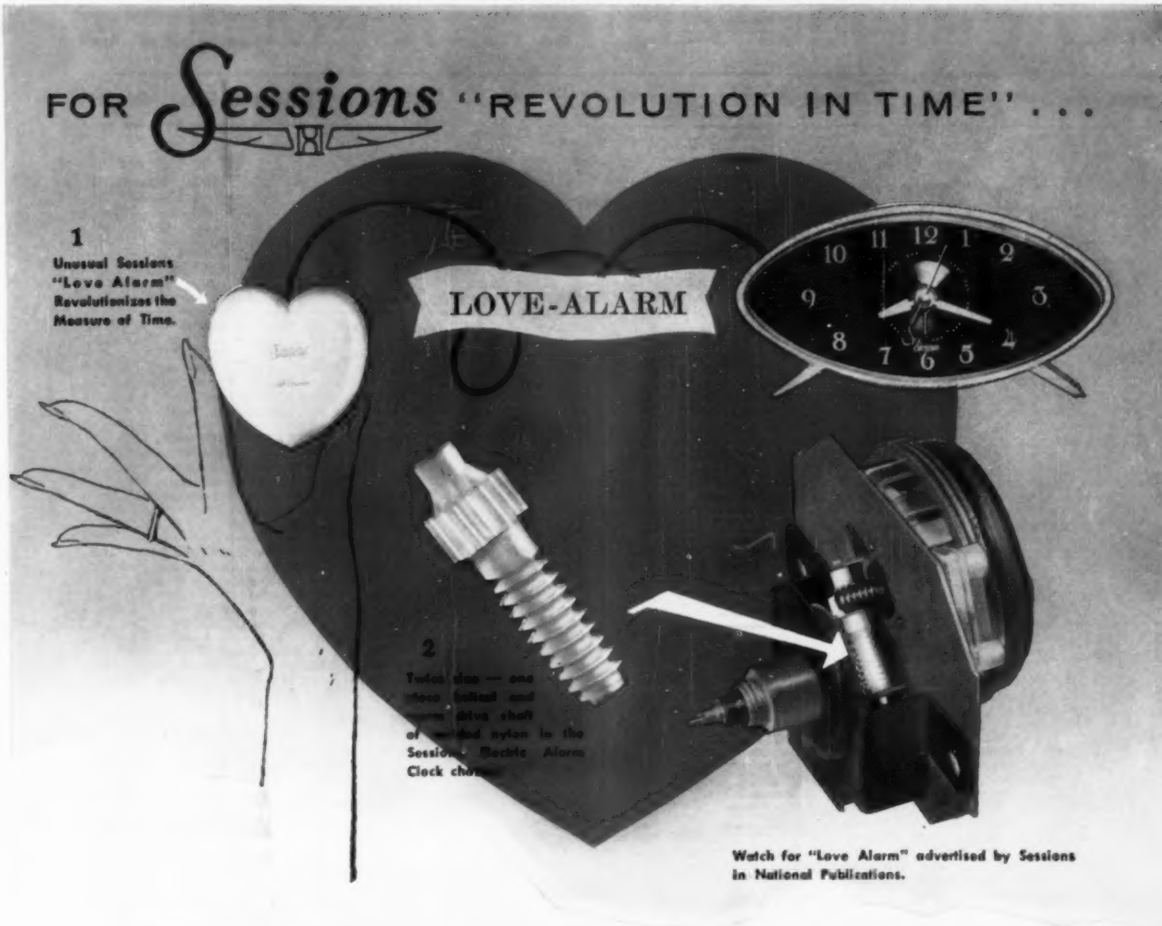
. . . **Hamlin & Morrison Co.**, 216 S. Second St., Philadelphia, Pa., named sales rep. of **Mol-Rez Div.**, **American Petrochemical Corp.**, 3134 California St. N. E., Minneapolis 18, Minn., for Pleogen polyester resins for Eastern Pa., N. J., Md., Del., and Washington, D. C. . . . **Longhorn Sash & Door Co.**, Austin, Texas, and **St. Lawrence Glass Ltd.**, Cornwall, Ont., Canada, appointed distributors by **Filon Plastics Corp.**, El Segundo, Calif., mfr. of fibrous glass reinforced panels.

Corrections

Modern Plastics Encyclopedia Issue for 1960. **Sterling Extruder Corp.**, 1112 Baltimore Ave., Linden, N. J., a manufacturer of extruding machines, inadvertently omitted from Machinery & Equipment advertisers index, p. 836, "Extrusion Machines."

Plaskon, a nylon molding and extrusion compound, **Allied Chemical Corp.**, **Plastics & Coal Chemicals Div.**, should be listed under Type 6 Injection Molding and Extrusion in Part I of the Plastics Properties Chart; in error, it was listed under Nylon 6/6 Injection Molding and Extrusion.

In the Foamed Plastics Chart, p. 513, **Union Carbide Plastics Co., Div. Union Carbide Corp.**, was inadvertently omitted as a producer of vinyl foam. The company produces molded, open cell products in its Newark, N. J. plant.—**End**



Precision Molded Thermoplastics

by Quinn Berry

Here's a clear picture of Quinn-Berry versatility . . . two widely different molded thermoplastic components for The Sessions Clock Company of Forrestville, Connecticut:

1. The beauty of the simple precision molded thermoplastic "Sweetheart" case for Sessions revolutionary "Love Alarm" . . . a gentle "purring" beneath the pillow to awaken only one sleeper while the other sleeper sleeps. Simplicity itself!
2. Precision molded in one piece to exacting tolerances, the nylon helical and worm drive shaft for the Sessions clock mechanism is self lubricating for long service life and accuracy of operation. Moreover, the Quinn-Berry method of molding for one piece assembly resulted in sizeable cost savings—to the manufacturer.

Each of the above components presented an individual engineering design and production challenge . . . met handily by Quinn-Berry.

Present your components requirement to Quinn-Berry where the "Unusual is Routine". You will be satisfied with the result.

CHELSEA 50, Mass.
Joseph Leader
68 Marlborough Street
Chelsea 3-3484

CHICAGO 45, Illinois
R. H. Frish
Room 211
6349 N. Western Ave.
Ambassador 2-6005

DETROIT 35, MICH.
Harry R. Brothen Co.
16577 Meyers Road
Diamond 1-3454

EAST ROCHESTER, N. Y.
Dynatherm, Inc.
607 West Commercial Street
Phone: Ludlow 6-0082

KNOXVILLE, Tennessee
Harold J. Melloy
2100 Ailor Ave.
P. O. Box 3207
Phone: 2-5911

MILWAUKEE 13, Wis.
John Weiland, Jr.
7105 Grand Parkway
Greenfield 6-7161

ARDMORE, Pa.
Austin L. Wright Co.
P. O. Box 561
1 W. Lancaster Ave.
Midway 2-5113

WE FLY TO SERVE YOU FASTER!

QUINN-BERRY CORP.
2609 WEST 12TH STREET, ERIE, PA.
CUSTOM MOLDERS OF ALL TYPES OF THERMOPLASTICS

CLASSIFIED ADVERTISEMENTS

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

FOR SALE: Ovens, Grinders, Powder Mixers, Injection Molding Machines 1 oz. to 60 ozs. never used and used. Two-head Bottle Blowing Machine. Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Ill. TUxedo 9-1328.

FOR SALE: 6—New Farrell Birmingham 14" x 30" two roll Mills. Watson-Stillman 240 ton, ten 24" x 56" platens. Baldwin-Southwark 200 ton semi-automatic transfer molding press. 225 ton 16" record presses. French Oil 120 ton self-contained. Hydraulic pumps and accumulators. New ¾ oz. Bench Model Injection Machines. Van Dorn 1 to 2½ ounce. Other sizes to 100 oz. Baker-Perkins and Day jacketed mixers. Plastic Grinders 1½, 5 HP, and up. Seco 6" x 12" and 8" x 16" mills and calenders. Plastic Extruders new ¾" and up. Single and Rotary preform presses ½" to 4". Partial listing. We Buy Your Surplus Machinery. Stein Equipment Company, 107-8th Street, Brooklyn 15, New York.

MOST MODERN PACKAGING AND PROCESSING MACHINERY Available At Great Savings. Package Machinery, Hayssen, Scandia, Wrap King, Campbell, Miller Wrappers. Pneumatic Scale Automatic Carton Feeder, Bottom Sealer, Wax Liner, Top Sealer with interconnecting Conveyors, Pneumatic Scale Tite Wrap. Fitzpatrick Models D and D-6 Stainless Steel Comminuters. Baker Perkins and Day 50 and 100 gal. Steam Jacketed Stainless Steel and Steel Double Arm Mixers. Day, Robinson 50 to 10,000 lbs. Dry Powder Mixers, Jacketed and Unjacketed. Werner & Pfleiderer 3,000 gal. and 3,500 gal. Jacketed Double Arm Mixers. Mikro Pulverizers, Model 1SH, 2TH, 3TH and 4TH. Colton 2RP, 3RP, 3B, 5½ T Tablet Machines. Stokes DD2 and Eureka Tablet Machines. Standard Knapp, A-B-C Ferguson Carton Sealers. Union Standard Equipment Company, 318 Lafayette Street, New York 12, N. Y. Phone: Canal 6-5534.

FOR SALE: MOLDING MACHINES: 48 oz. Jackson & Church, Universal Hydraulic Compression and Injection Molder, 570 Ton cap. Mfg. 1951—Like New. 28 oz. Watson-Stillman, 1946. 12 oz. Watson-Stillman, 1940. 8 oz. Reed-Prentice. 10D8, 1940. Ferro Equip. Co., 5454 Bellevue, Detroit 11, Mich. WA 5-2230.

REMOVAL SALE—(MOVING TO NEWARK, N. J.) PRICES SLASHED 20 TO 50%; 1—Baker Perkins 100 gal. Sigma blade Mixer; 1—Baker Perkins size 16 TRM, 150 gal. double arm, Vacuum Mixer; 1—Rotary Cutter; 1—Kent 6" x 14" three roll mill; 6—Stokes Model DD2, DS3, and B2 Rotary Preform Presses; 4—Stokes Model "R" single punch Preform Presses. Also: Sifters, Banbury Mixers, Powder Mixes, etc., partial listing; write for details; we purchase your surplus equipment. Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

LOOK AT THIS! Stokes 150 Ton Compression Molding Presses, complete with timers, controls, and Vickers hydraulic power systems. 1000 Ton Hydraulic Press, 10 openings, 37" x 37" steam platens with lift table. Cumberland #1½ Rotary Scrap Chopper with 10 HP M.D. 26" x 84" 2 Roll Plastic Mill; top cap, late type, excellent condition.
PLASTIC EXTRUDERS: NRM 1½", 2½", 3½", Royle 3¼"; Electrically heated long barrel extruders in 1½" and 2½" sizes.
INJECTION MOLDING MACHINES: Reed Prentice 12 oz. Model 300-T, with low pressure closing and Ross Cooler. Inspect under power. 16 oz. HPM, complete with Wheelcos. Save on location. We Will Finance. Johnson Machinery Company, 683 Frelinghuysen Ave., Newark, New Jersey. BIgelow 8-2500.

EQUIPMENT FOR RUBBER AND PLASTIC PROCESSING FOR SALE AT REALISTIC PRICES! Unused 2 Roll 14" x 30" Mills; Farrell Birmingham Design; Late type Top Cap Design; each with Uni-Drive at an astounding low price. Thropp 2 Roll Mill; 16" x 42"; late style top cap design. Farrell Birmingham 2 Roll Mill; 22" x 60" with 150 HP Motor. Eemco 2 Roll Mills 24" x 84" complete with accessories. Adamson 3 Roll Calender 28" x 84" with controls, motor drive, etc. Guillotine Rubber Stock Cutting Machine with 5 HP Motor. Two Roll Saw Tooth Crushers; several available. Baker Perkins Model 300 Continuous Ko-Kneaders; Jacketed for Heating or Cooling. Baker Perkins Dbl. Arm Heavy Duty Mixers; Jacketed; 100 gal., 150 gal., 200 and 300 gal. SPECIAL: Stainless Steel 300 gal. Vacuum Mixer; Dbl. Arm; Bottom Dump Discharge. Farrell-Birmingham Banbury Mixers Sizes No. 9 and No. 11; complete. NEW FALCON Double Ribbon Blenders; Steel or Stainless; All Sizes in Stock. Sturtevent No. 10 Tumbling Batch Mixer; 300 cu. ft. 10' Diameter; 9' Long Stainless Steel Resin Kettles; Jacketed, Agitated; Sizes to 3000 gallon. Adamson Automatic Vulcanizer; 6' x 16'; 125 PSI ASME, 7½ HP; Taylor instruments. Jackson & Church Vertical Autoclave; 41" x 54"; Jktd. 100 PSI; ASME; 300 Gal. Baldwin 600 Ton Hydraulic Press; 42" x 42" Steam Platens (11) 26" Ram; 50" Daylight; 22" Stroke; complete. Stewart Bolling Hydraulic Press; 36" x 36" Steam Platens (2); 450 Ton 23" Ram; 15" Daylight; 14" Stroke; complete. Watson Stillman 75 Ton Hydraulic Press; 12" x 12" platen. Denison 4 Ton Hydraulic Press; motorized with 3 H.P. F. J. Stokes Rotary DD2 23 Station Pre-Form Press; Vari-Speed 7½ HP. Other Pre-Form and Tablet Presses by Stokes, Colton, Kux. Allen 8" Strainer Type Extruder; Jktd. cored worm; 75 to 100 HP required. Hydraulic Vertical Extruding Strainer; 15" 3200 PSI. Full Details on any item and Price by Return Mail. FIRST MACHINERY CORP. INC., 209 Tenth St., Bklyn. 15, N.Y. STerling 8-4672.

FOR SALE: 1—Baldwin Southwark 150 ton self-contained compression molding press 24" x 24"; 2 Cumberland 7" stair step dicers, stainless steel; 2—MPM 1½" and 2½" electrically heated plastics extruders; 2—25 and 70 cu. ft. jacketed steel ribbon blenders; 1 Stokes R-4 dual pressure preform press; also granulators, mills, mixers, etc. Chemical & Process Machinery Corp. 52 9th St., Brooklyn 15, N.Y. HY 9-7200.

FOR SALE: 43—Baker-Perkins #17, 200 gal. jacketed mixers, sigma and duplex blades, many with individual 30 HP motors and drives, power-screw tilts. 2—Bakers-Perkins 100 gal., sigma or dispersion blades, jacketed. 3—Baker-Perkins 50 gal., sigma blades, jacketed. 2—J. H. Day 35 gal. sigma blade. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: (23) Potting Presses, 100 Units per hr. Cap., Bed 24" x 24". Vertical Injection Press, (with modifications, can be used as ¾ oz. injection molders) manually controlled with micro switch which sets into operation cycles for performance of potting operation. Motor drive activates agitator for flow of materials (plastic from a hopper into a heating cylinder). Mfg. 1951—Like New. Ferro Equipment Company, 5454 Bellevue, Detroit 11, Mich. WA 5-2230.

1—50 Ton Stokes Automatic—April 1955—#751—Serial #G-28323. 1—50 Ton Stokes Automatic—January 1956—#751—Serial #M-48244. 1—50 Ton Stokes Automatic—June 1956—Serial #M-48355. 1—12 oz. Watson-Stillman, Model 3295—Machine No. 9293—34 x 31 Platen—24" Stroke—220V 60 Cycle 3 Phase 1 Weight Feeder. 1—4 oz. Reed-Prentice—1492—single link—Serial #30086—Model #10AA—220V 60 Cycle 3 Phase. Note: Above two machines are in fair condition. 1—Brenner Preform Machine #P4-2404D58 complete with motors, static eliminators, deflectors, pressure tank, cutters, spray gun, hose and fittings plus 48" dia., turntable. 1—DeVilbis Mixer Type QMX #5065. 1—1946 Defiance #45—200 ton Preform Press. Reply Box 6108, Modern Plastics.

ONE—LESTER INJECTION MOLDING PRESS: Model L-3-10-12. Serial No. 177. Recently overhauled, new links, plunger advance. Price: $4800.00. Ankney Co., 8007 Grand Ave., Cleveland 4, Ohio.

FOR SALE: Lester Molding Machine L2½-8 oz. May be seen in operation. Art Plastics Co., Inc., Leominster, Mass.

FOR SALE: Hydraulic press, 4 cylinders 20 ton each, separate control for each unit, 12x12 die space each unit. 18" opening 5" stroke. Like new, used only a few hours. $3000. C Frame hydraulic press 2½ tons 18" stroke almost new $900. Western Tool & Die, 5407 27th N.E., Seattle, Wash.

FOR SALE—VINYL EMBOSSER: One 60" Waldron Embossing Unit Complete With Variable Drive—Variable Heating And Cooling Units Letoff And Windup—Can Be Seen In Operation—Machine In Good Mechanical Condition. Reply Box 6109, Modern Plastics.

FOR SALE: One Westinghouse Insulation and Oil Test Set includes a high voltage oil insulated self-cooled transformer, variable auto transformer for voltage regulation, AB De-ion air circuit breaker, Instantaneous trip relay, indicating lights and volt-meter. 5 KVA, 1 HR., 110/220 VOLTS TO 0-30000/60000 Volts, 1 Phase 60 Cycles. Charles S. Moorman, 8600 Stahelin, Detroit (28) Mich., Phone WOodward 1-0430 or TIffany 6-1411.

FOR SALE: Fellows 8 oz. molding machine, new in 1955. Low pressure closing. Leeds & Northrup instruments. Has been well maintained and is in excellent running condition. May be seen in operation. Sterling Plastics Co., 1140 Commerce Ave., Union, New Jersey.

FOR SALE: 5—French Oil Mill Machinery Co. Self Contained 200 ton slab side presses. 16" down acting ram, 24" stroke, 44" daylight, Bed area 24" x 30", 6" Pushbacks and stripping cylinders. 10 HP Vickers Hyd. units and controls. Price, FOB Akron, Ohio, $4,250.00 ea. 1—1948 NRM 2½" Extruders, 42" Screw, Electric Heated, 10 K.W. M. G. Set, Barber Colman Controls. 1—Baker Perkins Lab. Mixer Sigma Blade, Complete. 1—1952 Hartig 4½" Extruder, 72" Screw, 40 HP V.S. Drive. Barber Controls. 1—20 x 22 x 60 Adamson United Mill, 14" Water cooled bearings, single base motor and drive. 1—#3 Banbury complete with motor and drive. Write or Phone: Brewster Rubber Machinery Company, 349 East Exchange Street, Akron 4, Ohio. FRanklin 6-2911 or FRanklin 6-6791.

FOR SALE: Several Impco Model HA 12-300 injection molding machines. Excellent condition—All late model—Can be seen in running condition. Also available, auxiliary equipment, granulators, feeders, etc. Reply Box 6110, Modern Plastics.

Machinery wanted

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass. PLeasant 7-7747, 5222 West North St., Chicago, Illinois, TUxedo 9-1328.

WANTED HPM 80/100 OZ. 1955/56/57—1000/1200 Tons clearance between tie rods 40" x 48". Write: GPI 30 rue Massenet Coeuilly-Champigny, France.

WANTED: A used Hydraulic Press 12" opening for plastic sheet size 48" x 60" 1000 P.S.I. Pressing cycle is short; breathing latches wanted. Desire Automatic loading and unloading equipment. Reply Box 6111, Modern Plastics.

WANTED: 4 to 6 oz. Injection Molding Machine! T. D. Shea Co., 7026 E. 7 Mile Rd., Detroit 34, Michigan.

MACHINERY WANTED: Wanted to buy used Van Dorn scrap granulator. Model G100. Reply Box 6112, Modern Plastics.

(Continued on page 264)

SINCLAIR Propylene

Quality—99+% Purity
Quantity—Commercially Available

The purity of Sinclair propylene is very nearly perfect. The removal of harmful impurities permits polymerization and other reactions without the danger of catalyst poisoning or troublesome side-reactions.

Sinclair, the only commercial U.S. producer of this high-purity raw material, can make prompt shipments of your propylene requirements—in cylinders, transport trucks or tank cars—direct from Sinclair's Marcus Hook, Pa., plant.

Take advantage of this new high-purity product. Write or call for complete information and samples.

TYPICAL TESTS

MONO-OLEFINS	
Propylene (wt.%)	99.5
Other	0 ppm
PARAFFINS	
Ethane	100 ppm
Propane	0.5%
NON-HYDROCARBONS	
Oxygen	6 ppm
Nitrogen	10 ppm
Carbon dioxide	6 ppm
Water	25 ppm
Sulfur	4 ppm

SINCLAIR

Petrochemicals, Inc.

Subsidiary of Sinclair Oil Corporation
600 Fifth Avenue, New York 20, N. Y.
155 N. Wacker Drive, Chicago 6, Ill.

(Continued from page 262)

Materials for sale

GENERAL PURPOSE, MEDIUM AND HI-IMPACT POLYSTYRENE AND POLYETHYLENE molding materials for sale in any color or quantity. Packed in 50 lb. bags. Now at our lowest prices in years. For top quality materials, at big savings, write: Gering Plastics division of Studebaker-Packard Corp., Kenilworth, N. J., Dept. M. Or call: (N.J.) BRidge 6-2900.

FOR SALE: Virgin Linear Polyethylene, natural and colors, regularly available, save 40%. Reply Box 6113, Modern Plastics.

Materials wanted

WANTED: Plastic scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 514 West 24th Street, New York 11, N. Y.

GET THE TOP MONEY FOR PLASTIC SCRAP: Now paying top prices for all thermoplastic scrap. Wanted: polystyrene, cellulose acetate, vinyl, polyethylene, butyrate, acrylic, nylon. All types and forms including rejects and obsolete molding powders. Fast action wherever you are located. WRITE, WIRE TODAY! Reply Box 6100, Modern Plastics.

WANTED: All types of plastic scrap and surplus inventories such as: styrenes, butyrates; acetates, acrylics, and polyethylenes in any form. Write, Wire or Phone Collect. HUmboldt 1811. Philip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York.

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

WANTED: Vinyl and Polyethylene Scrap. Send description and small sample. We are continuous buyers. American Vinyl Corp., 73-30 Grand Ave., Maspeth 78, N.Y. Tel.: DEfender 5-9200.

WANTED: Butyrate, Kralastic, Cycolac. Also: Styrene, Acetate and Other Plastic Scrap. Claude P. Bamberger, Inc., Ridgefield Park, N.J. HUbbard 9-5330.

Molds wanted

Wish to purchase Houseware Molds of all types for injection molding. Please submit full information. Reply Box 6114, Modern Plastics.

Help wanted

REPRESENTATIVES WANTED: for the foremost manufacturer of die cutting equipment which trims a practically unlimited amount of rule of plastic or plastic-like materials. Additional products include: packaging machinery now making the most successful blister packages. Our machines can meet the requirements of small or large production. Various territories open throughout the United States. Send us a complete resume outlining experience, other lines, & following. Reply Box 6101, Modern Plastics.

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 29 E. Madison St., Chicago, Ill.—Wabash 2-4800. Call, write or wire—in confidence.

WANTED: Manufacturer's Representative with product ideas adaptable to injection molding by midwestern injection molder desirous of establishing proprietary items. Reply Box 6106, Modern Plastics.

DESIGN ENGINEER TO HEAD NEW DEPARTMENT: Must have knowledge of Plastic Molding Procedures and Molding Characteristics of Plastics. Position entails designing and developing a line of small fluid control devices. M.E. degree helpful, but not essential. A. Schrader's Son Division, 470 Vanderbilt Ave., Bklyn., N.Y. NE 8-4000 Ext. 236.

WELL-KNOWN and old established Rocky Mountain manufacturer seeks manufacturers representatives to make sales calls for industrial plastic work. New plant equipped to produce high-quality injection-molded plastic parts and able to provide tooling, stamping, roller painting, silk screening, etc. Send inquiries to Box 6104, Modern Plastics.

EXTRUSION SPECIALIST: With thorough knowledge and experience in set-up of extruded precision shapes, close tolerance tubing, for permanent position in New York with old, established custom extrusion company. We are looking for man with actual working knowledge, not administrator. Assistance will be given in relocation. Position offers chance for advancement. Reply Box 6105, Modern Plastics.

UREA AND MELAMINE MOLDING POWDER EXPERT: Expanding Chemical Company requires a Chemist or Production Man completely familiar with every stage of Urea and Melamine Molding Powders production from the basic resin through to the finished powder. Location: Metropolitan New York Area. Excellent opportunity for top man to participate on a profit-sharing basis with new producer of molding powders. Please give complete details of experience in first letter. Reply Box 6102, Modern Plastics.

MANUFACTURERS' REPRESENTATIVES to handle choice line of automatic plastic injection molding machinery in following areas: North and South Carolina, Virginia, Georgia, Florida-Puerto Rico, Alabama, Mississippi, Louisiana, Missouri, Tennessee, Kentucky, Southern Illinois and Indiana, Chicago-Milwaukee, Iowa, Oklahoma, Kansas, California, Washington-Oregon. Interested only in hard-hitting individual or organization with qualifications to handle sales and service for this profitable line. This is a major line but compatible lines are acceptable. In reply furnish full resume of qualifications and experience with present organization structure. Reply Box 6115, Modern Plastics.

ENGINEERS: Immediate openings for young ambitious engineers with an organization that has an outstanding growth history. CHE or ME degree with up to ten years of experience in research and process development. Your future in our organization is limited only by your ability. Located in Greenville, South Carolina, our new air-conditioned plant is in the foothills of the Great Smoky Mountains with its attendant excellent educational and recreational facilities. Resume including salary requirements to W. R. Grace & Co., CRYOVAC Division, P. O. Box 233, Simpsonville, South Carolina.

ENGINEER: PLASTICS EXTRUSION. Graduate preferred with mechanical design experience and practical knowledge of plastics extrusion field, to be responsible for design and development projects. Please write describing experience, education, salary required, to J. Badonsky, Chief Engr. Extruders, Waldron-Hartig, Div. of Midland Ross Corp., Mountainside, New Jersey.

SALES REPRESENTATIVE: Southwestern manufacturer basic in the thermoplastic resin production has excellent sales opportunity for man with at least three years experience. Salary open. Reply Box 6116, Modern Plastics.

RUBBER AND VINYL CHEMIST: Leading manufacturer of vinyl and rubber products desires man with experience in rubber and vinyl compounding and processing. Prefer experience in both but not essential. Excellent opportunity in development and production. Salary commensurate with experience. Replies confidential. Reply Box 6117, Modern Plastics, giving complete resume.

PLANT MANAGER: To assume full responsibility for all production and maintenance activities of small thermosetting plastic molding compound plant. Experience in this or related field desired. Engineering background or equivalent experience required, preferably mechanical. Send complete resume, including salary history and requirements. All replies will be acknowledged and treated confidentially. Reply Box 6118, Modern Plastics.

PLASTICS MOLD ENGINEER: Progressive Midwest company with private product line has opening in plastic mold design. The man we hire will have had a minimum of five to seven years of experience in the design of injection, compression, vacuum and transfer molds, together with some tool room background. Replies will be kept confidential. The Cornelius Company, 201 Oak Street, Anoka, Minnesota.

MARKET DEVELOPMENT: Opportunity to join Spencer Chemical Company's expanding Plastics Market Development program in a position which will permit the use of sales and technical abilities. We are seeking men who have a chemical or engineering background, and preferably three to five years' experience with thermo-plastics. Please send detailed resume to: W. H. Swope, Jr., Personnel Manager, Spencer Chemical Company, 610 Dwight Building, Kansas City 5, Missouri.

TOOL DESIGNER: Well established growing proprietary molder is seeking man with approximately 10 years experience in injection mold design. Knowledge of modern injection molding machines desirable. Excellent opportunity. Send complete resume including salary requirements to Sterling Plastics Co., 1140 Commerce Avenue, Union, New Jersey.

SALES ENGINEER for machinery manufacturer selling to entire thermoplastics industry—materials manufacturers, compounders, molders, extruders, vacuum formers. Experienced machinery salesman, preferably conversant with the plastics industry. Strong both technically and saleswise. Territory: Middle Atlantic states with considerable travel. Salary commensurate with qualifications. All replies confidential. Reply Box 6119, Modern Plastics.

DESIGN ENGINEER: Aggressive, responsible engineer who can get things done quickly and accurately. Degree or equivalent with machinery design experience and preferably some knowledge of extrusion. Write describing experience, education and salary requirements to A. W. Pomper, Director of Engineering, Waldron-Hartig, Division of Midland Ross Corp., P.O. Box 791, New Brunswick, N.J.

WANTED: Production Superintendent or General Foreman experienced in all phases of polyester glass reinforced molding. Midwest location. Salary open. Send resume to Box 6120, Modern Plastics.

SALES REPRESENTATIVES WANTED: by young, expanding, aggressive laminating company. We laminate to Rigid and Flexible Vinyl in a great variety of materials and patterns for use by many manufacturers. Desirable exclusive territories open on commission basis. Reply stating territory desired to: Laminate Industries, 923 Old Nepperhan Ave., Yonkers, N.Y.

WE ARE LOOKING FOR MEN who are interested in Product Development and Improvement for the New Products group working in the Research Laboratories of one of the country's largest producers of printing, converting, and technical papers, and of imaginative packaging and containers. A technical background with experience in plastics, resins, elastomers, latices, or paper is the basic requirement to fill these new positions in our expanding Research organization. Add to this imagination, creativeness, and product-mindedness, and you describe the men we are seeking. Your inquiry with full resume will receive immediate confidential attention. Write to: Hugh E. Mellinger, Technical Employment Supervisor, The Mead Corporation, Chillicothe, Ohio.

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Miscellaneous

MANUFACTURERS REPRESENTATIVE: Territory both Detroit and Out-State Michigan. Technical education with wide sales background in custom work particularly with OEMS. Plastic experience. Need relatively local Injection and Compression molding accounts to complete package. Have excellent former and extruder in the area. Reply Box 6121, Modern Plastics.

Established, successful sales organization, calling on all molders of plastics throughout New England States, has opening for additional complementary line. Will furnish imaginative and aggressive sales coverage. Storage and display space available. Reply Box 6124, Modern Plastics.

WANTED FOR BLOW MOLDING PARTNERS: Top personnel who can contribute experience, molding or some finance for a 5 to 10 machine plant. Your replies will be kept in confidence. Reply to Acme Machinery & Mfg. Co., Inc., 20 South Broadway, Yonkers, New York.

MANUFACTURERS REPRESENTATIVE: Metropolitan New York and New Jersey area—Reliable and established company, experienced in Plastic Industry wish to represent plastic machinery of component manufacturer on sales and parts. Can also offer complete existing service and repair facilities. Reply Box 6125, Modern Plastics.

ATTENTION CUSTOM MOLDERS, FOR SALE, PLASTIC MOLDS: Now is the time to diversify: Proprietary Products . . . active consumer line doing $1,000,000 nationally. New products now being tooled. No equipment to buy. Opportunity for custom molder to get into long-established line selling to chain and dept. stores, mail order, stamp and premium houses, also jobbers. Bargain at $250,000 (Cash $150,000). Less cash if properly secured. Balance long term. Reply Box 6129, Modern Plastics.

SELFADHESIVE TAPES—colored and clear—of cellulose and vinyl, also masking from nondomestic factory. Contacts wanted to companies interested in selling this line. In some countries manufacturing licenses are available. Reply Box 6107, Modern Plastics.

PARTNER-EXTRUSIONS: Are you ready to go into business for yourself? If you are expert in either selling or producing plastic extrusions or blow molding you may be the man we are looking for to help start a new extrusions Co. Reply Box 6123, Modern Plastics.

Situations wanted

PRODUCTION CONTROL MANAGER: 37. BS, MBA, 16 years experience includes shop work, production control purchasing, inventory control, methods and systems analysis, cost control, and estimating in the injection, blow and rotational molding fields, desirous of obtaining position with growing, progressive organization. Reply Box 6131, Modern Plastics.

PROFESSIONAL PLASTICS ENGINEER: 14 years experience—all phases—injection molding, development, production, engineering, planning, purchasing, packaging, estimating. Desire executive position. Reply Box 6130, Modern Plastics.

PRODUCT, MARKET DEVELOPMENT: Married man, age 31, B.S. in Chem. Engr. with experience in urethane foams and coating films. Expert in mold release of plastics and rubbers. Desires responsible position in product development or technical service. Prefers North Central or Rocky Mountain location in non-metropolitan area. Reply Box 6127, Modern Plastics.

PLASTIC SALES: 10 years heavy experience selling injection molders, extruders, including film, and calenders all grades of virgin and reprocessed plastics principally polyethylene, vinyl and polystyrene. Prefer middle Atlantic, New England or Southeastern U. S. Territory. Young, married, College Degree, willing to travel. Will consider related fields or purchasing. Reply Box 6126, Modern Plastics.

CHEMIST, ORGANIC: Ph.D., Age 35. 3 years development experience polyurethane foams. 7 years additional experience research and technical service. Reply Box 6128, Modern Plastics.

SALES MANAGER: Are you technically good but need sales help? If so, I may be your man. I have had 15 years experience selling plastic extrusions, rigid and flexible vinyl sheeting, blow molding. I am looking for a small or medium sized company that needs sales help, and can offer an attractive proposal. Reply Box 6122, Modern Plastics.

RATES FOR CLASSIFIED ADVERTISING

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For purpose of establishing rate, figure approximately 50-55 words per inch. For further information address Classified Advertising Department. Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y. Modern Plastics reserves the right to accept, reject or censor classified copy.

INDEX OF ADVERTISERS

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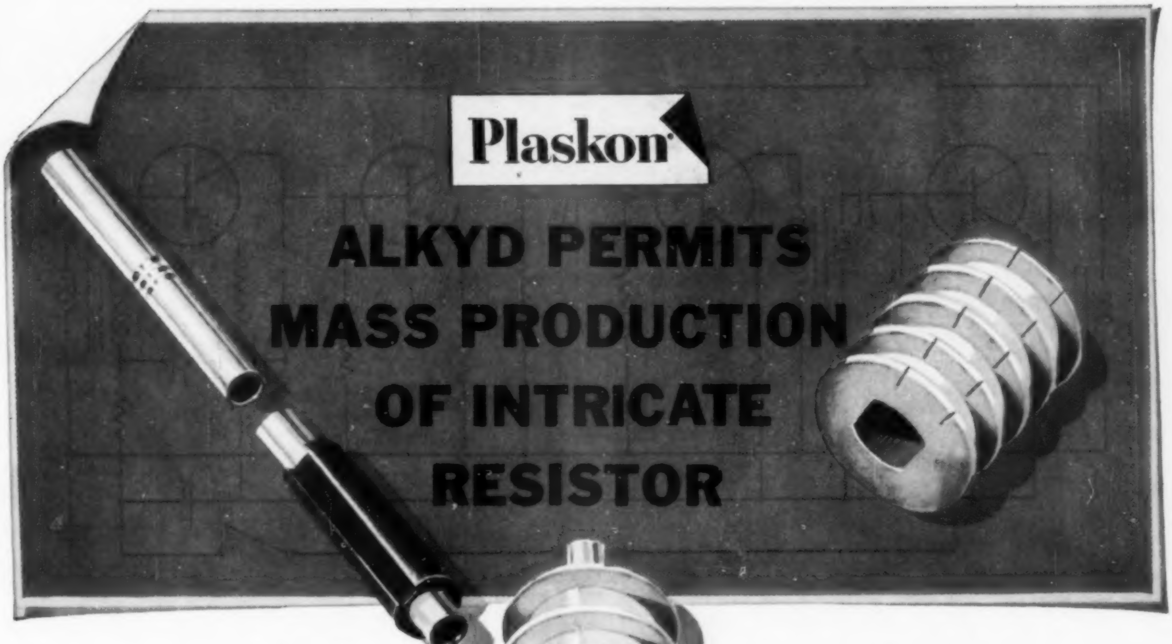

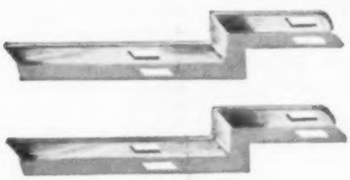

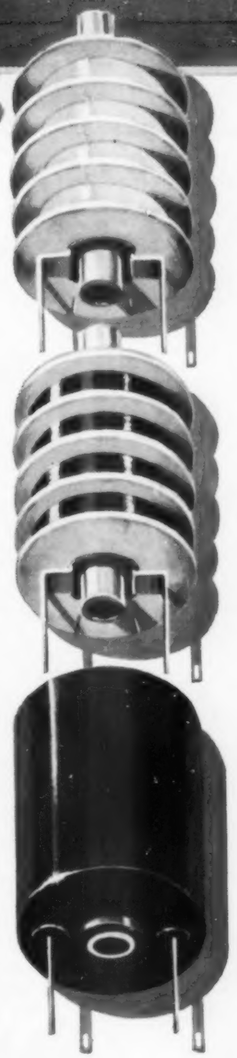

Encapsulation with putty-type Alkyd satisfies need for reliability by resistor maker and customers.

Today's creative engineers design with PLASKON Alkyd in mind for the manufacture of delicate electronic components. Here are reasons why electronic engineers prefer PLASKON putty-type Alkyds as *the* encapsulation medium:

- Simple to fabricate . . . molds quickly at extremely low pressures . . . permits rapid production cycles.
- Clean to handle . . . nothing to mix.
- Dimensional stability prevents distortion or damage to delicate inserts.
- Coefficient of linear thermal expansion is similar to that of popular wire alloys . . . reduces strain in service . . . aids the functioning of encapsulated units.
- Thermal conductivity helps to dissipate heat faster, resulting in less change in resistance value before and after encapsulation.
- Available in colors, for coding.
- More economical than most encapsulating processes.

Ultronix, Inc., San Mateo, Calif. manufacturer of quality electronic components, effectively utilizes PLASKON putty-type Alkyd in resistor production. The resistor pictured above in several stages of assembly includes an ingenious combination of three Alkyd parts—each one molded within the other—a most severe test of dimensional stability, moisture resistance, and consistency in performance. This resistor is built to meet or exceed all requirements of MIL-R-93B and MIL-R-9444.

PLASKON Alkyd Molding Compounds are outstanding for the qualities most necessary in molded parts for electronic and electrical applications. Competent Plaskon representatives will be glad to discuss material recommendations and fabricating techniques to fit your performance requirements. Telephone your local Plaskon representative or write to:

PLASTICS AND COAL CHEMICALS DIVISION
40 Rector Street, New York 6, N. Y.

Allied Chemical

(Continued from page 268)

MODERN PLASTICS
A BRESKIN PUBLICATION
PUBLISHED BY BRESKIN PUBLICATIONS INC. 575 Madison Avenue, New York 22, N. Y.

Finish Plastic Products
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NASH
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An automatic multi-spindle Rotary Finisher that performs ALL these operations:

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- TRIMS
- CRIMPS
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Accommodates circular moldings up to 4½" in diameter, 8" in height. Continuous and intermittent operation.

Remove FLASH *Faster . . .*

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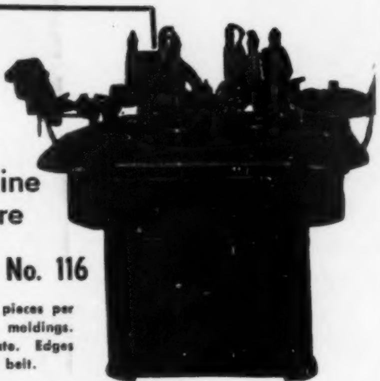

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Perfect finish—12 to 36 pieces per minute. 3" to 11" die moldings. Fast, automatic, accurate. Edges finished by final buffing belt.

WRITE for complete Bulletins covering NASH No. 193 Flash Lathe and No. 116 Rotary Edger

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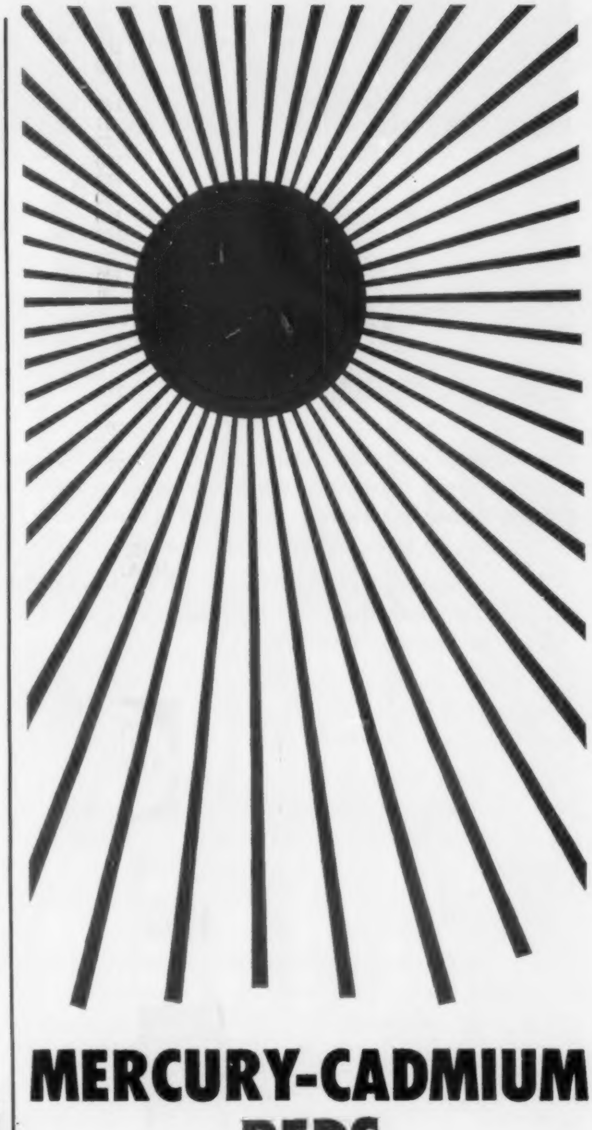

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EDITORIAL

Oh! those lovely disposables!

The editor of our sister publication, *Modern Packaging,* once made a speech before a plastics packaging group in which he decried re-use packaging. He jarred a few folks from their seats when he said, "Your future is in the trash can!"

That he was right has been proved by recent history. Not only plastics packaging, but also increasing numbers of plastics products are disposable.

Our front cover this month shows a prime example. Luxurious-looking landscape drapes made of polyethylene at prices that even paper drapes couldn't meet.

Another good case in point is paint brushes. Only two years ago you would have paid $4 for a 2-in. sash brush with a varnished wood handle and genuine Chinese pig bristle. Today you can buy an equivalent brush with a polyolefin handle and synthetic bristle for 49 cents. Use it a couple of times and throw it away!

In a big Chicago cafeteria they wash no cutlery. Knives, forks, and spoons are molded of styrene and are thrown away after one using.

We now have disposable tablecloths, flashlights, razors, tumblers, picnic plates, surgical gloves, footwear. All are made of plastics. And all are quality products even though priced to be disposable.

This is only the beginning. As materials come down in cost and high-speed automated processes evolve, more disposable plastics products will be introduced.

It is only a matter of economics and ingenuity. The American public will always provide a market for good quality products—especially disposable products.

Hiram McCann

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